# THE CORNELL ENGINEER

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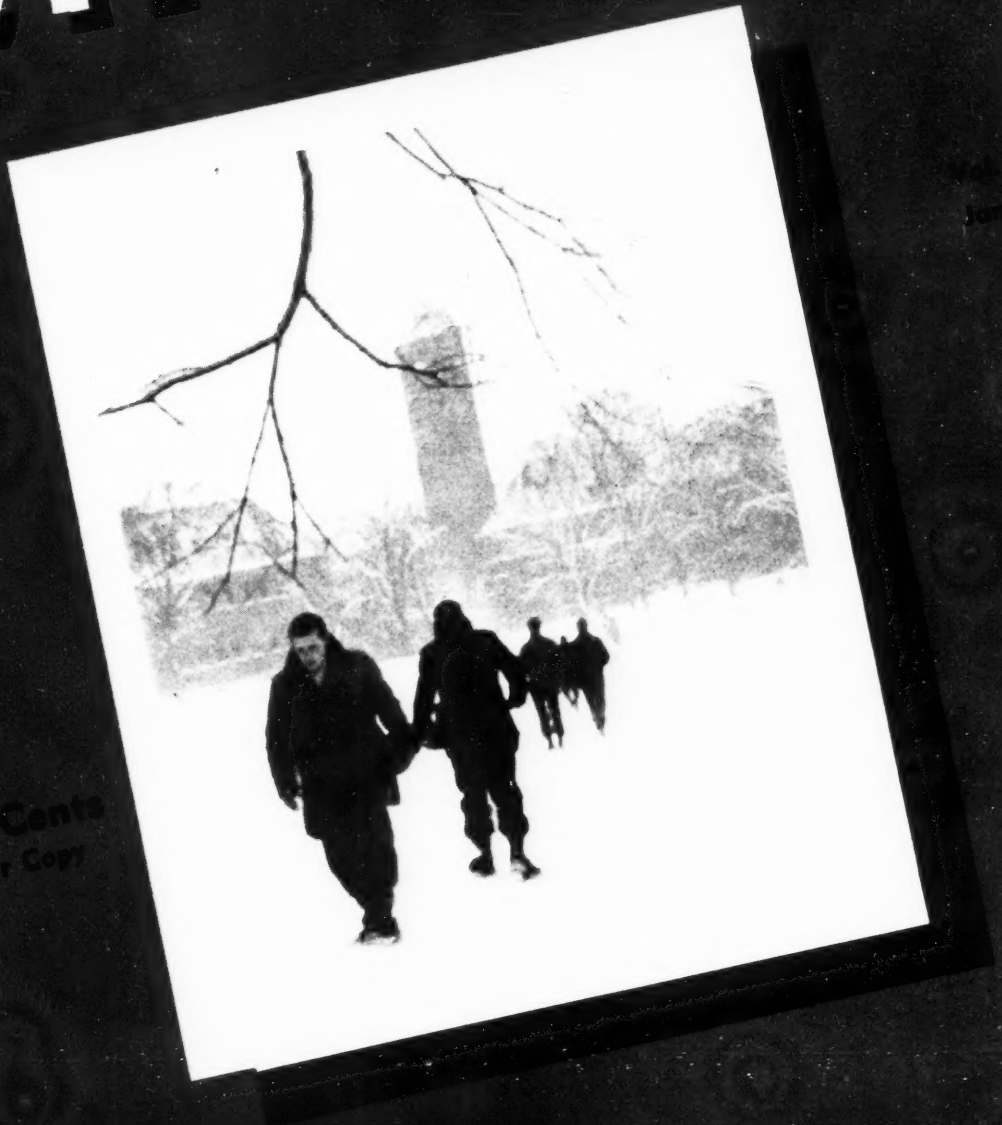

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# The CORNELL ENGINEER

Volume 13 Number 4

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**Cover:** Winter scene on the quadrangle.

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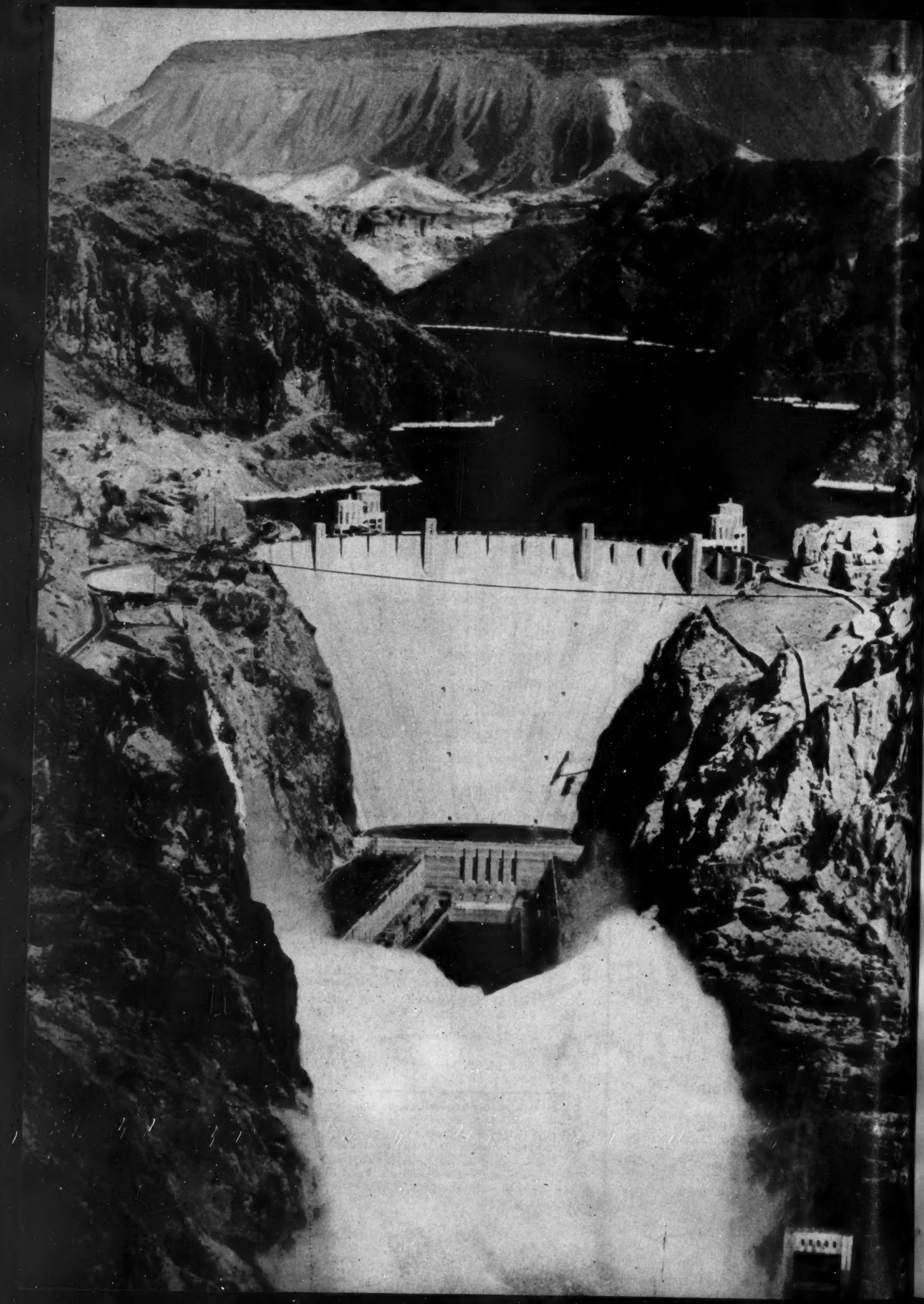

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**History**

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Vol.

# Expanding the Athens Water Supply System

By REGINALD H. KEAYS, C.E. '95

In these days when the United States is vitally interested in Greek affairs, by way of restoration of public works destroyed during and since World War II, it is well to refer briefly to what has already been done by Americans for the water supply of Athens.

A topographical description of the country around Athens includes some unique features. In our childhood geographies the Egean Islands were described as isolated mountains rising above the sea. We have similar conditious around Athens, except that the mountains are higher and the spaces between are plains formed by the outwash from the mountains.

If one stands on top of the Acropolis which rises in the midst of the Plains of Attica, at a distance to the south can be seen Phaleron Bay and the City of Pireaus, the port of Athens; to the southeast lies Mt. Hymettus; to the northeast Mt. Pentelicon; to the north the Parnes range, and to the west Aegaleus Mountain. All around the Acropolis lies the City of Athens with Lycabettus Hill a short distance to the northeast.

### History of Aqueduct

Speaking generally, all public water supplies since ancient times in the Near East have been derived from springs or other underground sources. There has been a belief that surface waters are unfit to drink. Long after Greece had become a part of the Roman Empire, Hadrian, who about A.D. 130, had been Archon of Athens and later was Roman Emperor, caused the Hadrian Aqueduct to be built. This aqueduct is a small tunnel about 16 miles long. It traverses the Attica Plain from Lycabettus Hill to the base of Parnes Mountain where it taps some springs and also collects ground water by infiltration. The amount of water collected has always been small, but until Greece obtained its independence from the Turkish Empire in the last century there was only a small population around Athens. During the Middle Ages the existence of the aqueduct was doubtless forgotten. The only evidence was the small flow of water on the slope of Lycabettus Hill.

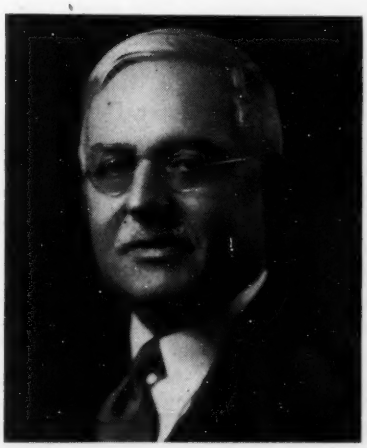
There is a story about the rediscovery of the aqueduct. It seems that one winter day about a hundred years ago, after a light snowfall, which is unusual in Athens, an observant gentleman was taking a walk in the country. As the warm snow melted he noticed with surprise that the snow melted first in a series of circular patches all lined up in a row. Naturally this required explanation, so these spots were

Hoover Dam, whose name was recently changed from Boulder Dam by Congress, is still the world's best known example of modern dam construction.

*—Courtesy of General Electric*

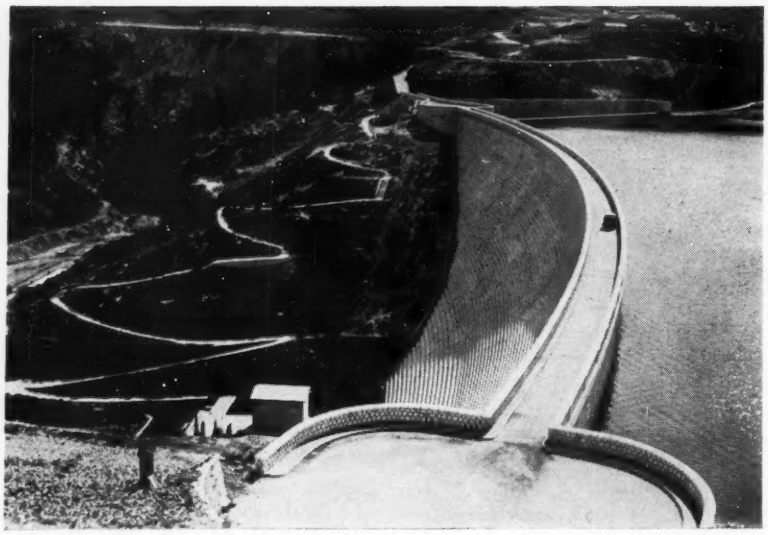
**THE AUTHOR**

**Reginald H. Keays instructed in civil engineering after his graduation from Cornell in 1895. He joned the U.S.V. Engineers in the Spanish-American War, and afterwards became assistant engineer in the Department of Havana for the War Department. Mr. Keays has been an engineer for several companies and projects including the Hudson Companies on Hudson River Tunnels, the New York and New Jersey Construction Company, and the Moffat Tunnel Commission. After serving as Chief Engineer of Ulen and Co. in Athens, Greece, he held positions with the Public Works Administration on Rapid Transit Subway and Queens Midtown Tunnel, and with the Reconstruction Finance Corporation on the Brooklyn-Battery Tunnel.**



**Reginald H. Keays**

**During the last war, Mr. Keays worked on the development of the Big Inch and Little Pipe oil lines.**



**The beautiful mosaic exterior of the Marathon Dam can be attributed to the lack of Portland cement in Greece at the time of construction; thus marble blocks were employed to face this gravity-type dam.**

marked out and later, digging down at these places for a short distance, circular slabs were found, which on removal uncovered small masonry-lined shafts. Further explorations made by descending the shafts disclosed a small tunnel in which a considerable quantity of water was flowing. This led to the re-discovery of the whole aqueduct.

### Preliminary Survey

Since the Greek people have had a country of their own, the population has grown so that now about a million people dwell in Athens, Pireaus and their environs and the old Hadrian supply is practically of no account whatever. During this time many plans were advanced for a new water supply, but nothing of importance was done until, in 1919, the Bank of Pireaus, seeking a concession, requested the American firm of Ford, Bacon & Davis to make a survey and report on a new water supply. The engineering force engaged by them was headed by the late Thaddeus Merriman and the late Walter Spear, both of the New York Board of Water Supply. In 1920 they made their report, the principal feature of which was a proposed dam in the Haradra River Gorge on the east side of Mt. Pentelicon, not far from the village of Marathon and the Marathon Plain. This was probably the only suitable dam site in southern Greece. Temporarily the water to be collected in the reservoir created by this dam was to be the runoff from part of the Parnes Mountains and other nearby mountain districts. The permanent supply was to include the discharge of several large springs at the base of Mt. Parnassus, about one hundred miles away to the northwest. The small water supply from the Hadrian Aqueduct was not included in the proposed works.

This project was not accepted by the Government on account of its high cost. Soon after, however, there was a large increase of population due to the influx of refugees from Asia Minor, so the Government decided to construct the temporary supply. In 1923 they instituted a competition among four European engineering firms and offered a prize for the best design for such a supply, based on a dam on the Haradra River as recommended by Ford, Bacon & Davis. The winner of the first prize submitted a design which was adopted by the Greek Government. It differed radically from the Ford, Bacon & Davis layout in that the aqueduct line followed the so-called "long route" along the slope of the mountain overlooking the Marathon Plain. The Ford, Bacon & Davis design specified a route for the aqueduct that required a tunnel under the saddle between Mt. Pentelicon and the Parnes Mountains, the so-called "short route."

In 1925 a cost plus fixed fee contract was negotiated by the Greek Government with the American firm of Ulen & Company for a detailed design of the system and for its construction and financing. The financing was to be shared with the Bank of Athens, and the work was under the jurisdiction of the Ministry of Communications with a Control Committee in direct charge.

### Work Begun In 1925

Work on the project was begun in 1925. More surveys, plans and studies were made and rainfall data collected, from which it soon developed that Ulen & Company thought it advisable to make some changes in the adopted plan. Against considerable opposition from the Control Committee practically all the changes were finally accepted. The principal change was the adoption of the "short route."

The various important features of the project are stated briefly as follows:

(1) The Marathon Dam on the Haradra River.

(2) The Marathon Reservoir created by the dam.

(3) The Control Tower and North Gate Chamber on the western edge of the Reservoir to control the inflow into the Boyati Tunnel.

(4) The nine mile long Boyati Tunnel, the so-called "short route" carrying the water under the saddle between Pentelicon and Parnes.

(5) The Drainage Tunnel leading from the base of the Control Tower and North Gate Chamber at its intersection near the north end of the Boyati Tunnel to an outlet in the side of the gorge below the dam.

(6) The short Helidonou Tunnel taking the water from the Boyati Tunnel and delivering it to the Athens siphon of cast iron pipe.

(7) The Athens siphon delivering the water to the Filtration Plant.

(8) The modern rapid sand Filtration Plan which purifies the water and delivers it to the Middle Service Reservoir.

(9) The Middle Service Reservoir, the distributing reservoir for the whole system.

(10) The main service pipe, a steel pipe extending all the way through the City of Athens to Pireaus and connecting to all distribution lines, to the high service reservoir, filled by pumping and to several regulatory tanks automatically controlled.

(11) The small Stamata Dam and Tunnel, which is a diversion dam on Stamata Creek and a tunnel to the reservoir.

A more detailed description of the various features are given below in the same numerical order:

(1) *The Marathon Dam*:

The underlying rock in this part of Greece is largely a poor grade of mica schist which is usually capped by permeable marble strata. At the site of the dam the lower part of the rock gorge is in schist and the upper part in marble, and it was decided to limit the height of the dam to the schist cross section. This was quite high enough anyway, considering the area of the water shed. The resulting design was a dam of gravity cross section about 57 meters (187 feet) in height and 285 meters (935 feet) long, and slightly arched upstream to better fit the topography. Blow-off valves were installed at the base of the dam, and a gate house, a replica of the ancient Treasury of Athens at Delphi, constructed downstream of the dam. The rock underlying the dam was thoroughly grouted to prevent seepage.

The only suitable rock for the structure was found to be marble obtainable by opening a quarry in nearby massive ledges at the edge of the gorge. An efficient crusher plant was set up near the dam site and aggregate both large and small produced for the cyclopean concrete which was used for the core of the dam. The dam is faced with roughly cut polygonal marble blocks fitted into one another to form a mosaic pattern.

At that time no suitable Portland cement was produced in Greece, and all the cement was imported from several countries in Europe.

(2) *The Marathon Reservoir* formed a beautiful lake which, when filled to spillway level at 223 meters above the sea, had a capacity of 41 million cubic meters. The Haradra River is joined by the Varnava just upstream from the dam and the two rivers widen out into a broad basin, the reservoir.

(3) *The Control Tower and North Gate Chamber* is located a short distance south of the north (reservoir) portal of the Boyati Tunnel. It extends from water level to the intersection of the Boyati Tunnel with the Drainage Tunnel. The lower part of the structure is a shaft in rock lined with concrete and the upper part is a marble-faced tower extending well above water level and connected to the bank by a bridge. Control valves and Venturi meters are housed in this structure.

(4) *The Boyati Tunnel* constructed in the years 1926 to 1931 is nearly nine miles long. It has a horseshoe shaped cross section, 7.5 ft. by 7.9 ft., and the greatest depth below the ground is about 600 feet. It was driven mainly from the two ends to a low apex about three miles from the north portal through a great variety of geological formations, all bad. In 1928, however, a shaft was sunk at about the middle of the length and some tunnel driven both north and south.

The Boyati Tunnel is lined for almost its entire length with concrete blocks, which usually had to be placed immediately behind the heading because of water and unstable ground. These blocks were erected in successive continuous rings, each ring consisting of six blocks, mutually self supporting. They were about six by six inches in cross section.

### Tunnel Not Waterproofed

For the greater part of the length of the tunnel the ground water level was far above the tunnel. No attempt was made to make the tunnel watertight, as any water leaking in increased by just so much the permanent water supply, and in fact the final leakage added about ten per cent to the supply from the reservoir.

For a short distance, however, not far from the north portal there was a stretch of about 1900 feet where the rock was fissured marble, and the ground water level was far below the tunnel. This part of the tunnel was heavily gunited in an endeavor to make the tunnel completely watertight. Hydrostatic tests put on the tunnel before putting it in service indicated that the guniting was completely successful.

At the north end the tunnel was partially excavated from the North Portal, but in 1928 access to the

(*Continued on page* 34)

**This view of the interior of the Boyati Tunnel clearly shows that no attempt was made to make the concrete block interior waterproof. Notice the icicle-like deposits of mineral matter on the roof of the tunnel.**

**From Graduate To Engineer**

# TRAINING FOR LEADERSHIP

By HOWARD J. SANDERS, Ch.E. '47

*All illustrations courtesy Calco*

His courage is there, yet long accustomed to a select environment which gives its principal emphasis to scholarly accomplishments, the college graduate enters upon a career in industry with a vague sense that he is not altogether equipped for the task immediately ahead.

The graduate's background has very obviously been academic. Consequently, he finds that his training has confined him within strict limitations. The university curriculum, by its very nature, must stress basic theory and the manipulation of ideas. The graduate will quickly discover that, particularly should he step into a position of supervision, his greatest preoccupation will in reality be hard particality and the manipulation of men.

Upon entering industry, the engineering graduate, unlike the average employee, must receive highly unconventional treatment. The responsibilities of the ordinary workman are limited. His outlook may also be limited, and there is no resulting handicap. However, assuming that within a few years the typical graduate will be charged with major responsibilities, his perspective must of necessity be all-encompassing. He must at no time allow the broad expanse of company operations to escape from view merely because of the insistent demands daily imposed by their detailed particulars.

**Industrial Training**

To answer the needs of college graduates, training programs in industry have been developed. Their object is not to fit graduates into industry by providing slightly modified college extension courses in better-than-average industrial settings. By a painstaking-and-well-directed program, the graduate is gradually allowed to grow into his new responsibilities while on the job and while systematically exposed to working conditions of all sorts. After this extended and thoroughgoing training, involving supervised work in many phases of plant operation, the new employee is finally capable of assuming his proper role in industry.

Trainees must learn the rudiments of leadership by starting at the lowest rungs in the organizational ladder. In this way, all the while that these men work their way upward, the training program has assured them that they have for support the basic understandings and the diversified experiences which are the essential underpinnings of success.

**Job Satisfaction**

A guiding principle of any industrial training program is that employees are most likely to exert their best efforts consistently and with greatest satisfaction to themselves if engaged in work for which they show special aptitude. Otherwise, economic waste and personal disillusionment result. Under a training program, new employees are eventually permitted to select the jobs at which they are most skilled and which hold for them the greatest appeal. Of course, immediate company requirements may also be involved, although every effort is made to place employees in the jobs for which they are most suited.

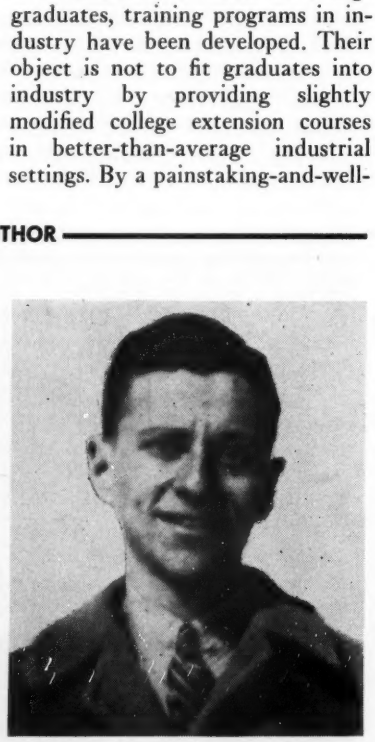
Training serves the constructive purpose of giving the worker a clear sense of direction. In time, he sees his job not *in vacuo* but as an integral part of a cooperative undertaking toward which he may make lasting contributions.

During 1932, Calco made its first

**THE AUTHOR**

**Howard Sanders graduated from Cornell last June with the five-year degree of Bachelor of Chemical Engineering. Immediately thereafter he joined the Calco Chemical Division of the American Cyanamid Company in Bound Brook, New Jersey. At present he is participating in Calco's technical training program for recent college graduates.**

**Mr. Sanders was editor of his high school newspaper. In college he wrote several articles for, and served on the staff of, the CORNELL ENGINEER. He has co-authored an article on heat-resistant paints, which appeared in the December, 1947 issue of "Product Engineering."**



**Howard Sanders**

stab at technical training. Sixteen venturesome college graduates began what for Calco was a completely untried experiment in industrial education. For several of the trainees, the indoctrination period finally ran to two years. For others, it was completed in a year or less. In all cases, however, the plan was the same. The trainees were allowed to tour the various divisions of the plant to become completely familiar with all aspects of company management. Once the program was completed, the men, if possible, were assigned to responsible jobs of their own selection at various levels of production, supervision, purchasing, engineering, process development, and personnel management.

Today many of the trainees of 1932 and those of subsequent years are kingpins in the Calco organization, assuming positions of responsibility with but few exceptions.

In each year following 1932, more young college graduates began their tours of training. The programs continued substantially unchanged. However in 1941, under the stress of war, the programs were reluctantly cancelled. But in 1945, they were started once again.

Toward the close of last year, the urgency of providing a much more detailed training program than ever before became increasingly evident. The need for supervisors with high degrees of skill grew with each passing month as production schedules began shooting up. A new Calco plant near Parkersburg, West Virginia, was being rushed to completion, and held excellent promise of some day exceeding even the three hundred acres of the Bound Brook plant. Only a greatly expanded and vastly more comprehensive training program for an unprecedented number of graduates could possibly do the job and do it well.

Including a varied assortment of company leaders, several of whom were former trainees, a technical training committee was established and went to work immediately. Once it had formulated the basic program for the 1947 course, the committee turned its attention to the selection of qualified trainees. In the early part of the year, various Calco representatives, among

**Engineering trainees at Calco don grease-stained coveralls and turn out actual work on a lathe.**

them the director of technical personnel, toured scores of universities throughout the country for the purpose of interviewing interested and eligible seniors. Over seven hundred applicants were considered. Of these, eighty-one received and accepted Calco's invitations to visit the Bound Brook plant for additional interviews with divisional managers, chief chemists, and other responsible parties. The careful screening of applicants continued uninterruptedly for many months.

When the program was finally begun on July 1, there were twenty-four trainees on hand, representing nineteen different universities from Maine to Colorado. Six trainees were added the following September. By far the majority of the graduates held bachelor or masters degrees in chemical engineering, although several held degrees in chemistry, geology, industrial engineering, or business administration.

### Proper Perspective

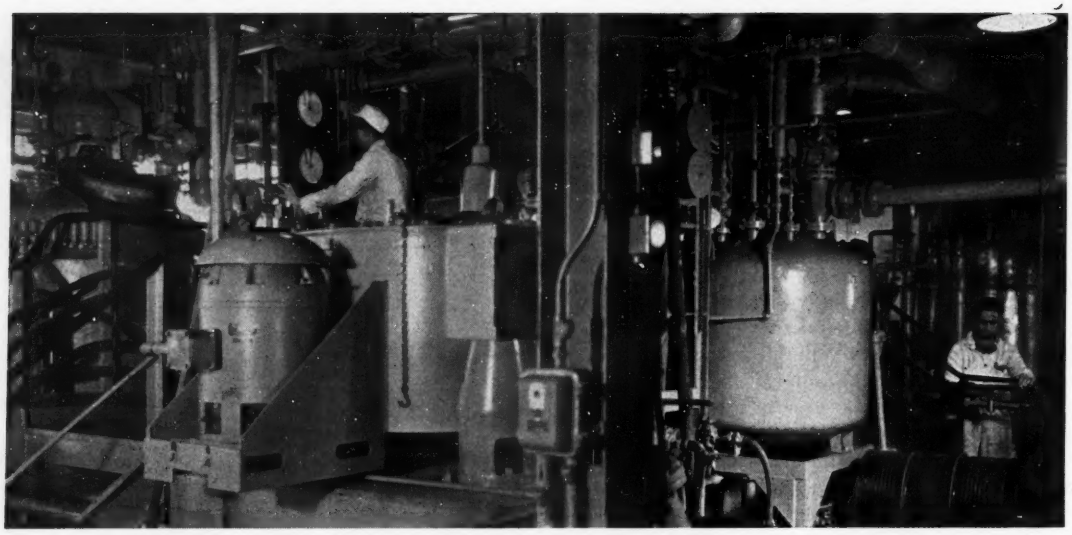
As an entirely new feature, the 1947 program began with an orientation period. The introductory sessions included talks by various company managers and were interspersed with guided tours through the plant. Company history, plans, policies, organization, and production methods were discussed with thoroughness and candor.

At the completion of the orientation, the fundamental instruction period began. Each trainee was assigned a separate job schedule for the year. Although all the trainees within the year would follow substantially the same course, the sequence of departments toured was properly adjusted to permit a uniform distribution of the training load throughout the plant. The program included application laboratory, process development, maintenance, production, engineering stores, accounting, control laboratory, safety, purchasing, sales service, standards laboratory, and scheduling.

### Tours of Duty

The unique features of a department as well as the length of time allotted to it usually decide the nature of the instruction offered by that department. In all cases, nevertheless, the time is predetermined by the relative importance of that department in the overall organizational structure, as well as the complexity of its operations. The minimum time is two days; the maximum is eight weeks.

In each of the major divisions, such as process development, engineering, production, and maintenance, not only is the training period relatively lengthy, but learning-by-doing is practiced without exception. For instance, in the pharmaceutical development laboratory,

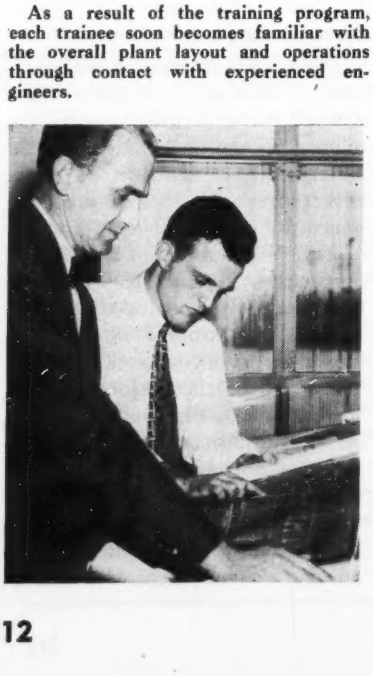


**By following the work of these skilled operators, the trainees learn the basic principles of chemical manufacture, in this case the production of pharmaceuticals.**

the trainee is fitted directly into the regular experimental program then in progress. A special development problem is turned over to him for his independent investigation, and all the resources of the laboratory are available to him for his use and study. Supervised usually by the chief chemist, the trainee within a short time develops a close familiarity with problems characteristic of development laboratories in general.

During his five weeks in the engineering department, the trainee spends four weeks in any one of several divisional engineering offices, such as pharmaceuticals, coal-tar products, acids, fur dyes, or vat dyes. The remaining week is devoted to a resume of engineering operations and includes visits to the central engineering offices and the drafting rooms, as well as to the flow sheet, the instrument engineering, the plant layout, the electrical engineering, and the scheduling departments. Farmed out to several departmental leaders, the trainees quickly gather a balanced appreciation of engineering operations within the company.

**As a result of the training program, each trainee soon becomes familiar with the overall plant layout and operations through contact with experienced engineers.**



Somewhat less creative than the training offered in both the laboratories and in engineering is the week's tour of the safety department. In this case, the trainee each day joins the safety man as they circle the plant on their periodic checkups. The trainee also accompanies the inspectors when interviewing employees who have become involved in accidents while on the job. In this way, he becomes familiar with prevailing industrial hazards and the methods for their prevention. Because the chief responsibility for promoting safety consciousness among the workers rests with the departmental supervisors, the trainee, being good supervisory timber, must be fully informed concerning the most effective techniques of accident prevention.

### First-Hand Information

As another example of how methods of instruction are adjusted to fit the special characteristics of particular departments, the accounting division has a training procedure all its own. When assigned to the accounting department, the trainee is free to talk with the leading members of such sections as tabulating, budgeting, billing, general accounting, and cost accounting. In the course of two weeks, fundamental accounting procedures are carefully and systematically discussed with members of the central accounting department and with members of the divisional accounting offices. As may be surmised, the trainees actually do no work in the department.

Apart from these phases of instruction, the trainees are periodically asked to write technical reports. Each report is read by each member of the technical training committee. In this manner, not only do the trainees improve their skill at technical report writing, but the committee members gain more of an insight into the trainee's special interests and aptitudes. The training year also includes frequently scheduled interviews with members of the technical committee in an effort to give the trainees whatever guidance they may require.

A company can rightly judge the success of its programs by the number of its technical trainees who become the backbone of the organization. No other evidence in favor of technical training could conceivably be more persuasive.

# Plastics As Protective Coatings

By ALFRED N. MANN, ChE '50

*All photos courtesy Interchemical Corp.*

Tom Smith, a car dealer interested in the technical details connected with his merchandise, decided to find out the role of chemistry in automobile production. He called on his friend Paul O. Blackmore, B.Chem.E. '25, Technical Manager of the Finishes Division of Interchemical Corporation, an organization which specializes in the development and manufacture of finishes and protective coatings for industrial use. Smith was startled by the scientist's first statement: that his field was in plastics.

"You do make surface coatings, don't you?" queried Tom.

"Surely, but they're plastics just the same. A protective coatings expert uses the same chemical materials and reactions as does the man popularly classified as a plastics technician, the former puts his materials into solution and applies them to surfaces by means of a spray gun or brush, forming protective films, while the latter takes these substances and molds them into the familiar tabletops, kitchenware, and safety glass—solids useful in themselves. Research and progress in the two fields have been so closely interwoven that it is now difficult to distinguish between the two."

"I wonder if we might review the application of your phase of plastics chemistry to my industry," said Tom.

"Well, sir, I hope you won't consider it putting the cart before the horse if I start with the assembled mass of steel we call the car. The final step in the preparation of the body is the finishing operation by which the product is transformed into a polished, corrosion-resistant vehicle of pleasing appearance. I took this first because nitrocellulose, the lacquer used for this purpose, was the first-born of the long line of plastics we now know. Discovered over 100 years ago, it has been in industrial use since 1868, when Hyatt began the production of Celluloid in America. Nitrocellulose, or cellulose nitrate in proper organic chemistry nomenclature, is dissolved in organic acetates or similar solvents, sprayed on the car body, and deposited as a coating when the solvents evaporate. This is a representative example of the simplest means of film formation."

"That doesn't sound too simple. How much worse do the processes become?"

### Plastic Constituents

"As we go through the car we will find that all the finishes are dried by solvent evaporation, polymerization, oxidation, or combinations of these. But returning to the car body paint, you are quite justified in commenting as you did. Nitrocellulose alone will not adhere to the steel or give it much more than a temporary glossy sheen. Therefore we modify it by the addition of natural and synthetic resins which enhance the film-forming, adhering, weather-resisting, and gloss-retaining properties of the lacquer. Pigments are ground into the nitrocellulose base to impart the desired color and help

**Pressure lubrication equipment finished in Polymerin, a urea alkyd baking enamel, durable, and resistant to oils.**

reflect away the sun's rays, which, along with atmospheric moisture, are so destructive to the material being coated. Plasticizers and diluents do their share of extending the base, the former increasing its flexibility, the latter reducing its viscosity for spraying purposes. The entire combination is dissolved in a mixture of solvents found most appropriate for the conditions of application."

"How much of a film remains after the drying process?"

"About 75% of a present-day lacquer is volatile. Therefore the engineering problem has involved increasing the solid content of the deposited film by modifying the constituents and by heating the spraying apparatus, and developments promise to give up to 40% solids in the future. Another source

of trouble is blushing, or the appearance of a milky area on the film when solvents evaporate too quickly and atmospheric water vapor condenses on the suddenly cooled surface. The colloidal suspension thus produced disperses light abnormally, thereby ruining the pleasing tone of the car finish. Adjustment of the solvent balance—the ratio of active solvents, latent solvents (active only in the presence of the others), and diluents—gives the answer to the problem."

Tom wondered if other inferior products were sometimes used. "I've seen autos that wouldn't take much of a shine at all compared to others. Where does the difference lie?"

"Let's not be hard on the fellow who prefers to coat his car with synthetic enamels. They are used in modern practice because they don't require the factory operations of sanding and polishing. They do mar somewhat when you or I try to shine them up a bit, but they are constantly being improved in that respect."

"On what chemical basis do you distinguish between synthetic enamels and lacquers?"

**Complex Resins**

"These newer, more versatile enamels dry by the mechanisms of polymerization and oxidation. The history of the more complex resins begins with the synthesis in 1909 of the familiar phenol-formaldehyde reaction product known as Bakelite. Since that time many chemically analogous substances have been used in the preparation of resins varying over wide ranges of specific properties. High resistance to corrosion of different types makes them ideally suited for coating the surfaces of metallic paint and varnish cans, food and drink containers, sea-going vessels, dams and locks exposed to salt water conditions, water tanks, and the like.

"Much of the electrical wiring in windings is insulated with plastic coatings of the Bakelite type, and now there are about as many specific coatings as there are sizes and kinds of wire. The wonderful thing about phenol-formaldehyde resins is their durability. Materials for wires, tin cans, and bottle caps are covered with resin, baker, and then processed into the desired shapes, all the while retaining their surface coatings unaffected by the crimping or other fabrication. As I said before, the solid films are polymerization products resulting from the interaction of the phenolic type constituent with the one based on formaldehyde. As such, they were found to have little of the adhesive strength required for protective coatings. But here again, as in the case of the lacquer, engineers were able to transform them into oil-soluble substances which now had the desired flexibility and also permitted solution in various organic solvents, facilitating application to surfaces."

Here Tom, a bit confused by the chemistry of drying, interrupted to ask why the constituents of an enamel didn't interact while in the container used to ship them. "The point here," continued Dr. B., "is that the liquids usually react to form the solid polymers only at high temperatures. The manufactured articles require a baking to allow the complex chemical reactions to take place. In the process, the volatile organic solvents are driven off, and the unsaturated compounds harden by the addition of atmospheric oxygen through the unsatisfied valence forces of their double bonds, while the primary reaction of polymerization is in progress."

"Ah!" responded Tom. "That's where our three main mechanisms of drying play their parts."

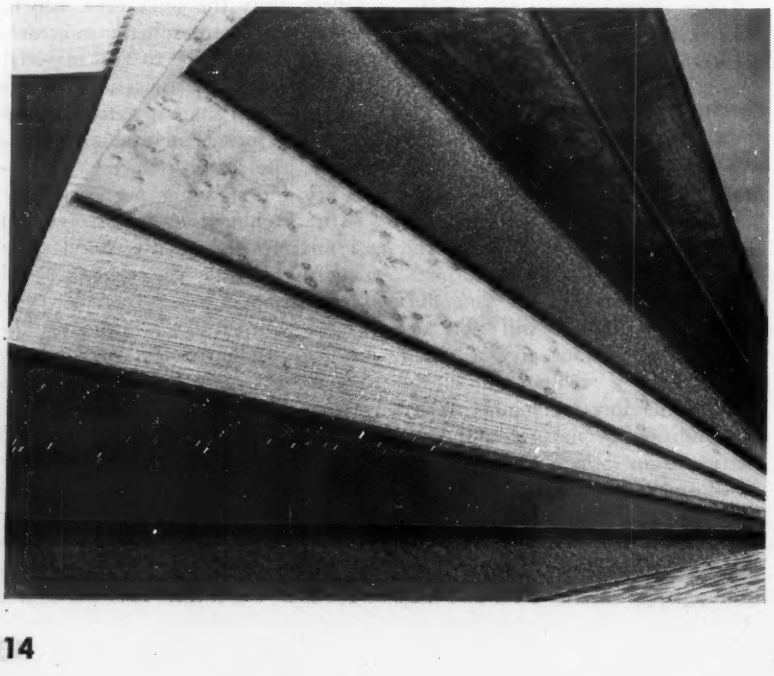
**Pre-dried Finishes**

"Right," was the answer. "But the finish producer who prepares his materials in kettles anyway can save his manufacturing clients a lot of time and trouble if he heats those kettles. In this way the polymerization reactions may be carried to partial completion before the objects are coated, and the resins may be reacted with certain oils such as tung to give a soluble substance. The final step is thus reduced to the application of the dissolved Bakelite dispersion resin and the subsequent drying mainly by means of solvent evaporation. Wartime airplane finishing operations were cut to five minutes when this type of pre-dried resin was used as a base or primer for the final painting. However, brittleness can stand correction."

"Phenol-formaldehydes do sound like useful substances. Can you describe some of the other plastics that have been developed more recently? Have they the answers to some of the problems left unsolved in the older ones?"

"Present-day plastics technicians find it difficult indeed to choose

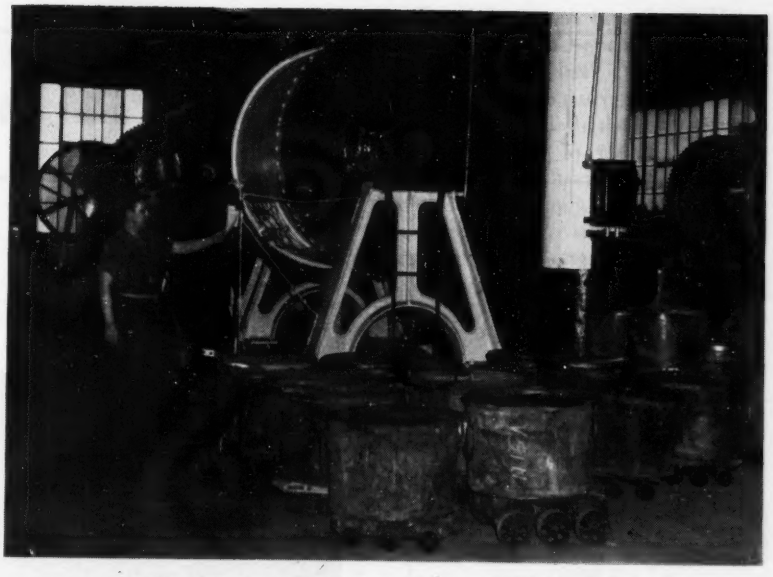
**Various types of wood and fabric reproductions which can be obtained with lacquers and finishes described.**



from the many varieties of polymers available for specific tasks. We might say something about those products which have found particular application in protective coatings. The most versatile among these are the thermosetting urea and melamine types."

"I don't recall your using the term *thermosetting* before as a classification of plastics. Could you explain?"

"The idea here is that all of our plastics constituents are, on a chemical basis, simply long repeating chains of simple molecular units. These may line up end to end in a relatively stable arrangement. Yielding under heat, or crosslinking may produce hard, infusible, three-dimensional structures. The former comprise the class of *thermoplastic* resins, while the latter are called *thermosetting*. Crosslinking is usually accompanied by the elimination of a small, simple molecule, such as water, by the mechanism of condensation polymerization. Urea was found to react with formaldehyde to give a dimethylol urea polymer, insoluble in ordinary organic chemicals and thus of little value for surface coating application. The colorless resin could be pigmented and molded into the solid plastic "Beetleware," but extension to our field came only with the discovery that reaction of the polymer with butyl alcohol resulted in a soluble material suited for protective coatings. In addition, mixing with other resins now became feasible, and many valuable combinations were worked out."



**Ball mill for pulverizing ingredients of protective coating.**

### Hardening

"And you describe the hardening as a case of condensation polymerization?"

"That's it. In phenol-formaldehyde resins we split out water molecules, and straight dimethylol urea does the same. The butylated form regenerates, in addition, some of the butyl alcohol originally used in solubilizing it. These gases are formed in the baking ovens all the time. Substitution of melamine, a cousin of urea, gives an analogous formaldehyde polymer with similar but more marked properties. Its resistance, durability, and short baking time represent a distinct improvement over older members of the family.

"And did this development affect the automotive industry?"

"Indeed it did. Ureas, melamines, and some of the others which we shall mention have been found useful singly and in combination in the preparation of highly colored coatings for metal surfaces. Automobile dashboard panels and moldings, trays, wastebaskets, and many other products with a simulated wood surface effect are made by coating flat metal or fabric sheets with the desired mixtures, baking, and then fabricating to the final shape."

"I can see the advantage in that. Imagine having to spray or hand paint those objects and get the same uniform lustrous finish."

"They are also applied directly to wood furniture, where catalyzed, controlled curing gives finishes quite superior to lacquer films in resistance to staining and marring, and in solid content. They lack the gloss of the older type. A great new field is now open, especially since highly polished furniture often has no particular appeal.

"Your wife's refrigerator walls, cabinets, stove, washing machine, and so forth, owe their beauty to special synthetic enamel baked onto them. Development of these enamels started with General Electric's alkyd resins, also known as glyptals in reference to the basic materials glycerine and phthalic anhydride. And, as in any of these histories, it wasn't long before chemical neighbors among the polyfunctional organic acids and bases were being interchanged in products representing a great spread of distinctive properties."

### Alkyds, Ureas, Melamines

"What do you think the future has instore for alkyds now that ureas, melamines, and the rest have been developed?"

"Their arrival served as a stimulant for further research in both the new and old fields. Practically any of these resins may find application in some coating designed to meet certain specifications. Often the best results are obtained when combinations are used. Thus a plain phenol-formaldehyde may provide a strongly adhesive base for a more gaily colored urea in a decorative finish. And the end of development is not in sight. Vinyls, vinylidenes, silicones, acrylates, and styrenes are some of the newer plastics materials not yet fully adapted for utilization in surface coatings."

"How much progress actually has been made?"

"Well, consider vinyls, for instance. Vinyl chloride and vinyl acetate copolymerize in various proportions into a thermoplastic resin

(*Continued on page* 36)

# PROFILE

## --Vladimir Karapetoff

By VICTOR K. PARÉ, EP '51

Honored and respected by Cornellians and non-Cornellians everywhere is Dr. Vladimir Karapetoff, Professor Emeritus of Electrical Engineering. Such affairs as the annual "Kary" dinner of the New York Alumni Chapter of Eta Kappa Nu Association are typical of the honors accorded this remarkable man, who, holding degrees in mechanical and civil engineering, taught electrical engineering at Cornell for thirty-five years and became one of the outstanding men in that field.

Born in Leningrad, Russia, 71 years ago, Dr. Karapetoff received the E.E. degree from the Institute of Ways of Communication in Leningrad in 1897. He attended Darmstadt Polytechnic Institute in Germany through 1899-1900, and then returned to the Institute in Leningrad to receive an M.M.E. in 1902. His chief interest, however, was apparently in electrical engineering, for he came to the United States soon afterwards and was employed at Westinghouse until 1904, when he became an Assistant Professor of Electrical Engineering at Cornell. Promoted to a full professorship in 1908, he taught until 1939, when he retired as a Professor Emeritus.

Undoubtedly the most striking characteristic of Dr. Karapetoff is his intellect, which has manifested itself not only in engineering work but in such fields as philosophy, music, and literature. He became very well known through his writings; and three of his books, *Experimental Electrical Engineering, The Electric Circuit,* and *The Magnetic Circuit,* all written about 1910, were very much used for a considerable length of time. While the books lack the theoretical background and thorough development of formulas that are available to the modern author, they are very clearly and concisely written, and provided those who studied them with quite adequate skill in making calculations concerning electrical machinery and power lines.

Dr. Karapetoff's lectures on Advanced Electrical Theory and Engineering Mathematics are said to have run often into psychological and philosophical topics, and he still gives interesting talks on such subjects. A year ago, at its annual "Kary" dinner, the New York Alumni Chapter of Eta Kappa Nu heard him speak on the fourth dimension, and a few months later he spoke to the New York Section of the American Institute of Electrical Engineers on "The Young Engineer and Human Society." These talks are well illustrated by models, diagrams, and analogies, and can always be counted on to be interesting. His advice to the young engineer includes five main ideas: that the engineer should gear himself to the five main factors in his life—country, family, culture, profession, and employer; that a person's quest for knowledge should be continuous throughout life; that a person should accomplish as much as possible of his plans and ideas during his life; that he should develop equally all four sides of his character—emotions, body, intellect, and will power; and that once time and opportunity are passed by, they never return. The last statement he emphasized by saying that the saddest words that can be written or said are, "It is too late."

**Dr. Vladimir Karapetoff**

Another outlet which Dr. Karapetoff has found for his literary and philosophical energies is the writing of poetry, a collection of which appeared in 1937, under the title "Rhythmical Tales of Story Years." It is quite a credit to him that he is able to write competent verse in a language not his own of birth. The poems are written in more or less free verse, with various rhyme and rhythm combinations used to aid in producing the desired effect. They often concern incidents seen or taken part in by the author, and are usually thoughtful or philosophic and sometimes humorous or lightly satirical, making generally pleasant reading.

It often happens that men of great scientific or mathematical aptitude are also good musicians, and such is the case with Dr. Karapetoff. He has given several series of public piano recitals but perhaps his most interesting musical achievement is the invention of a five-string cello, which he has demonstrated effectively at public concerts.

When those who know Dr. Karapetoff tell of him, the conclusion inevitably reached is that he is a man who has led a very full life. He is one of those people who is interested in all the things and people about him; one who has already learned and accomplished several lifetimes' worth of knowledge and work. His honorary memberships in Tau Beta Pi, Eta Kappa Nu, Sigma Xi, and Theta Xi, and his honorary degrees of Doctor of Science from Brooklyn Polytechnic Institute and Doctor of Music from the New York College of Music testify to his scholarship and personal charm.

# News of the College

## Professors Emeritus

Ernest W. Schoder and Charles L. Walker, both of the School of Civil Engineering, have been appointed to the rank of professor emeritus.

Professor Schoder obtained his Ph.D. at Cornell in 1903 and was appointed professor of experimental hydraulics in 1919. His works with hydraulics have covered almost the entire field, including many important papers on the flow of fluids in pipes, and the performing of many experiments on models of rivers, dams, and on hydraulic equipment.

Professor Walker received his B.C.E. at Cornell in 1904 and was appointed professor of sanitary engineering in 1922. He has written numerous reports on domestic and industrial wastes and has served as consultant on many sewerage and sewage projects throughout the country.

## Football Battle

On Nov. 12, the CE's and Architects resumed their traditional pigskin push on the quadrangle and battled to a 0-0 tie. Only extreme darkness halted the fight-to-death battle.

Naturally the CE's outpassed, out-ran, and out-foxed the T-squares, but the lone CE touchdown was called back on account of alleged out-of-bounds. Ken Stofer, heretofore unknown outside of professional, semi-pro, and amateur football circles was the spark of the CE team.

## Burrows Heads Panel

Dr. Charles R. Burrows, director of the School of Electrical Engineering at Cornell, has been named Chairman of the Panel on the Upper Atmosphere for the National Research and Development Board. The Panel, made up of key scientists and military men, assists in research on the upper atmosphere as a part of the Board's program. The Board is headed by Dr. Vannevar Bush.

## Mackey At Symposium

Professor C. O. Mackey, head of the Heat-Power Engineering Department of the Sibley School of Mechanical Engineering at Cornell, represented the university at a "Heat-Transfer Symposium" held at Oak Ridge, Tennessee, December 8-13. The symposium was conducted by the Nuclear Energy Propulsion for Aircraft Division of the Fairchild Engine and Airplane Corporation with the support of the Atomic Energy Commission.

## Mason Writes Book

Four lectures presented by him to the National Metal Congress in Chicago last fall have been published by C. W. Mason, professor of chemical engineering, in his new book, "Introductory Physical Metallurgy." His lectures were originally presented as a part of the Congress' educational program.

## ASME

The Cornell Student Branch of ASME showed movies of the building of the Golden Gate Bridge at San Francisco at a crowded regular meeting on November 13. Particular emphasis was given to the construction and anchoring of the bridge towers.

## Rocket Society

A captured German technicolor film, showing launchings of the V-2 rocket was shown by the Cornell Rocket Society on November 13 before an audience which completely filled Room 1, West Sibley. The film, taken during the war, showed several launching accidents and their destructive results.

## AIChemE

The main topic of discussion at the November meeting of the Cornell Chapter of AIChemE was the problem "What is the chemical engineer?" The discussion was directed by Professor J. C. Smith.

The group's award to the mem-

(*More news on page* 30)

**The following men were recently elected to Tau Beta Pi, national honorary society for engineers and architects:**

**Leif Arneson '49**
**Ray Carlton Bump '50**
**Kenneth Strauss Canfield '50**
**Thomas William Clements '48**
**Craighead Cowden**
**John Seymour Dana '50**
**John Wilmerton Darley, Jr**
**Thomas Augustus Foss '48**
**Gerard Francis Fox '49**
**John Bradford Friedrich '48**
**Jack Hahn '49**
**Girard Stone Haviland '48**
**William Leonard Hewitt '48**
**Benj. Michael Hildebrant '49**
**Eugene Leslie Hofmann, Jr. '49**
**James J. Jackson III '49**
**Berkley Johnson Jr. '48**
**James Willis Junkin Jr. '48**
**Thomas Henry Latimer '49**
**Homer Shannon Lundy '49**
**Paul Rowley McIsaac '49**
**William Samuel Owen Jr. '49**
**Robert Henry Russel Jr. '49**
**Ralph Ernest Schmidt '48**
**Jerome Schwarzkopf '48**
**Quinton William Simkins '49**
**Allan Wallace Trimpi '48**
**Frederick Sampson Turk '49**
**Edward Thomas Turner Jr. '48**
**William Wade '49**
**Robert Irwin Wagner '48**
**John James Wallace Jr. '48**
**Norman Elwood Woonton '49**

# The Editor's COLUMN

## Resolved:

To be a better engineer and citizen. This is probably the most noble resolution one could make; certainly it is the easiest to say and the hardest to keep. Anyway it's about time the engineer came out of hiding to set the world in shape. At least on campus, where a good head is in demand, he should help to run the show and not reserve his brain power just for textbooks.

Even the very best of us can afford to reflect and resolve this 1948. The warnings "to be conscious of the world situation" and "to remain honest and tolerant in all ways every day" may seem trite from too much repetition, but they must be heeded. I have been told that the engineer acts as the stabilizing influence in his community. As a professional man and a scientist, his opinions and decisions are respected highly, more perhaps than he ever realizes. Whether or not he knows it, in college the engineer must be prepared for this added responsibility. His training gives him the basic background of honesty, integrity, and the all-important scientific attitude. To prepare himself further for his role in later life, the college man needs most to keep informed of the world outside his daily sphere.

The best place an engineer can start is right on campus, working with his college community. Why not make this the red-letter year for doing all the things you've known you should do and have just been too lazy to start. What about joining your professional society and really backing your school activities? The spirit is there; it needs only the spark.

And so the CORNELL ENGINEER resolves to do as much as it can to encourage the engineer in all his activities and his associates. We shall foster the spirit and publicize the tradition. But we can't do it alone. Engineers, please resolve.

# PROMINENT

Jerry

## Jerome Schwartzkopf, EE

Out of slightly worn Franklin Hall this February will emerge another group of electrical engineers to try their luck with the elusive electrons. And one whose luck should be exceptional is Jerome Schwarzkopf, otherwise known as Jerry.

Jerry claims New Rochelle, N.Y., for his home town, and he attended New Rochelle H.S. He admits that one of the principle reasons he chose Cornell for his alma mater was that his brother, who had gone here, had many wonderful stories of Cornell life, which Jerry decided he just couldn't miss. Electrical engineering was natural for him, and McMullen Regional and Laverne Noyes scholarships have helped him on his way.

### Won Numerals

Before entering the Navy in his junior year, Jerry managed to set a high standard at Cornell. As a freshman, he won his numerals at crew. Since then he has been a member of the 150-pound crew, in which he has won his letter. He also spent two years working for WHCU.

In the Navy, Jerry became an A.R.T. (Aviation Radar Technician) and spent some time in the Philippines. He also spent a good portion of his service time in the West, where his prime ambition was born, to someday hitchhike back to the West Coast. Jerry returned to Cornell in the Fall of 1946 and since then has received further honors. He has been elected to Tau Beta Pi and Eta Kappa Nu, honorary engineering societies. He is also a member of AIEE and the Institute of Radio Engineers. But Jerry still seems to have enough spare time to pursue his crew, and work as an engineer for WVBR, campus radio station. Last summer found Jerry working at Western Electric in Kearney, N.J., with the title of "junior assistant

(*Concluded on page* 32)

## Lawrence Coleman, CE

Tired of making mud pies in the Ceramic Engineering School at Alfred, Lawrence Coleman decided to transfer when he left the Navy. Since he had always been interested in construction, he chose Civil Engineering and, after searching for the best in engineering schools, came to Cornell in November, 1945.

Larry spent a year at Alfred before the war and played on the

Larry

freshman football team. During the war he was a pilot in the Naval Air Corps and it was there that he met his wife-to-be who was a Wave mechanic. They were married in 1945, and are now living in Little Vetsburg.

After summer school, which he attended for two summers, Larry worked as a carpenter on construction jobs, the type of work in which he is most interested. He has made a number of pieces of furniture and is particularly proud of a Magnavox type cabinet he built for his radio phonograph. His favorite hobby is designing houses and he has a collection of about fifteen of his own design.

Larry is a member of Chi Epsilon, honorary Civil Engineering fraternity. Though not a member, he has very close ties with Phi Kappa Tau fraternity and attends many of their social functions.

After graduation in February, Larry hopes to get a job in construction work, preferably in some way connected with the building trades, and, after he gets permanently situated, perhaps build a full scale model of one of his houses.

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## Claude Roichel, ME

When Claude Roichel disembarked from a Cunard liner in New York in 1940, he had no idea that in but a few years he would be an integral part of a show to benefit infantile paralysis victims in a fairly remote section of upstate New York, or that he would be engaged in a venture to break into the newspaper game in the same region.

Born in France, and educated at Harrow, in England, he intended to further prepare himself for college and then go to an American university. And so, after two terms at Lincoln School he entered Cornell in September 1942, a prospective mechanical engineer.

Never one to let his studies interfere with his real education, Claude immediately became active in the Dramatic Club and was appointed photography editor of the *Daily Sun*. When it was decdied to produce a variety show, "Boys 'N Ivy" for the benefit of the Infantile Paralysis League of Ithaca he was chosen to act as Technical Director of the production.

**Claude**

In 1944 his extra-curricular activities were curtailed rather suddenly when the army decided that it needed him more than Cornell. After some training at Texas A&M he was sent to Oahu as a member of a topographic battalion. In some ways, Claude says, he considers being drafted a fortunate occurrence; for instance, for one term of Mech Lab at Texas A&M, where the course is easier than it is here, he received credit for two terms of Senior Mech Lab at Cornell.

Upon returning to school after his discharge Claude began once more to indulge extensively in activities on the hill. He is a member of the Octagon Club, and was managing editor of the short lived *Sunday Observer*. In addition to his other outside activities Claude manages to find time to operate his ham radio station, W2UUI.

**Berkley**

## Berkley Johnson, CE

The far west's contribution to Cornell's Civil Engineering School, Berkley Johnson, came east in 1941 after one year at the University of New Mexico. Like many other future engineers, however, his schooling was interrupted by a three year stretch in the Army. He entered the Army Air Forces in 1942 and flew a tour with the Eighth Air Force as a B-17 bombardier.

Berkley returned to Cornell in the fall of 1945 and has since set an enviable record at Lincoln Hall. He is a member of Chi Epsilon, Civil Engineering honorary fraternity, and was recently elected to Tau Beta Pi. In addition he has served, for the past year, as steward and treasurer of his fraternity, Phi Gamma Delta.

### Longs For A Mesa

Berkley doesn't particularly dislike upper New York, but does share a common desire with many other "foreigners" from west of the Mississippi to see a mesa rather than a Finger Lake once in a while. His only comment on the ENGINEER to date has been a profound "The World isn't ready for this yet," while reading "Out of Phase."

When he graduates in February of 1948 Berkley plans to by-pass his native Santa Fe and go to Alaska. Beyond that his plans are indefinite, but to those who know Berkley there is no doubt as to his future success.

**Recent Developments**
**In Engineering**

# Techni-Briefs

## Microwaves

High-power radio waves, of small wave-length and large frequency, which have very marked heating properties, can be produced by a new electron tube developed by GE. These microwaves can be used very effectively to heat many insulating materials and even to cook food and light cigarettes. Dr. Richard B. Nelson, of the GE research department, developed the tube during the war for the purpose of jamming German radar with short, powerful waves and since has modified it to do the work stated above. The tube is of the "magnetron" type which controls the electron flow by means of a magnetic field and produces waves eleven inches in length. Objects are heated most rapidly by waves of shorter length, approaching the size of the object as a limit. Despite the fact that most objects would be on the order of a few inches, a foot wavelength was chosen since waves shorter than that would produce non-uniform heating effects. With the power of five kilowatts, such intensity is produced that an arc may be drawn from the end of the antennae of Dr. Nelson's transmitter.

## Wide-Angle Camera

A new, wide-angle camera has been developed by Kodak for use by the U. S. Submarine Service. This camera, measuring about ten inches on a side, can be clipped to the periscope eyepiece and used to take shots four inches square at the rate of approximately one a minute. When snapped in quick succession as the sub moves along the shoreline, an accurate composite picture of the coast may be prepared giving the strategists a better idea of how to plan an attack. This was actually done during the last war when the first models of the camera were installed in subs doing reconnaissance along the Japanese coast. A very complete picture of the coast at possible invasion points was thus assembled simplifying considerably the projected plans for attack.

Aerial film in 20-foot lengths is generally used by the camera, permitting 50 exposures to a sheet. The camera itself weights 19½ pounds, has an f/6.3 lens focused at infinity, has a focal length of 127 millimeters, and has shutter speeds ranging up to 1/200 of a second.

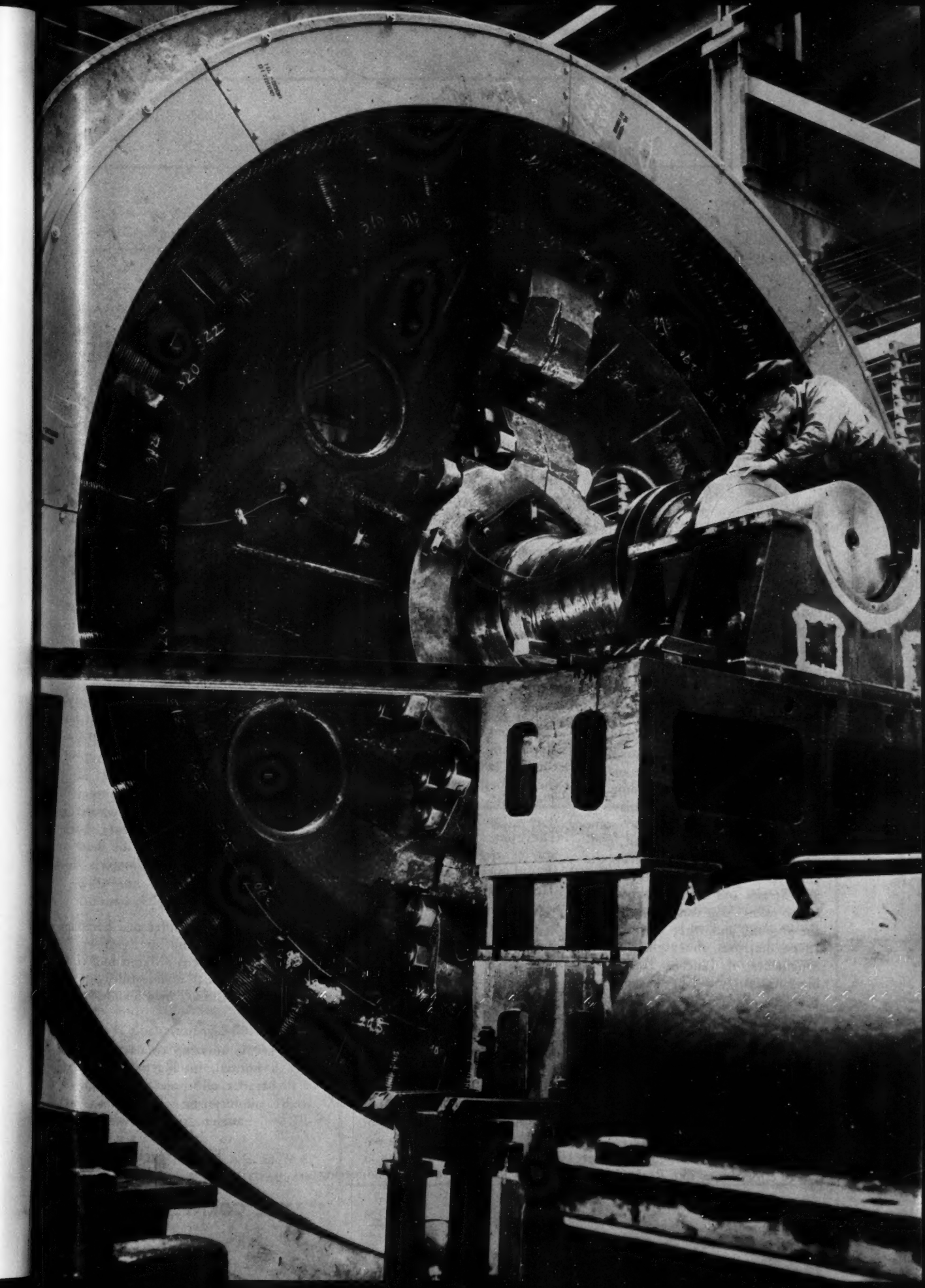
## Quantitative Analysis

A new application of x-ray diffraction technique has recently been developed by the North American Phillips Company for use in the rapid quantitative analysis of metals. The process involves a device known as the Norelco Geiger-Counter Fluorescence Analysis Unit which makes use of the angles of reflection of x-rays from the various metallic components of an alloy. The specimen under consideration is placed in a holder set up to handle four specimens. Then to determine the content of a certain metal in that alloy, the Geiger counter is set for a certain reflection angle which is constant for that metal. A crystal of some standard material, usually sodium chloride or calcium fluoride, is positioned in the holder at half the angle set previously on the Geiger counter.

(*More brief news on page* 24)

**T. C. Swartz of the GE Research Laboratory lights a cigarette with the arc from the antenna of the transmitter for 11 inch radio waves.**

**A worker adjusts the bearings on a giant 5,000 kw. synchronous generator with a stator frame 20 feet in diameter and a 43-ton rotor.**
*—Courtesy General Electric*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# Out of Phase

By HERBERT F. SPIRER, EP '51

## Darkness and Drudgery

As I lay on my marble slab in the dingy cell *they* call a room, I can only wonder morbidly, "What's the use of it all?" Why sweat and slave all day over a lukewarm professor and go home to get kicked in the face by Francis Weston Sears? Five years of grinding for what?

For Science? Fooey. Look what happened to my old buddy Steinmetz. Well do I remember his dying words as he leaned forward on his bed of nails, supported by two faithful squirrel-cage inductor motors. "Wo . .," he groaned, "Wo iss mein schlide rrrule?"

What is an engineer anyway? Just a guy who bows low from the waist every time he passes a drafting table . . . a bundle of eyestrain, frustration and benzedrine . . . a prelim book with ears . . . a slide rule with curvature of the spine . . . coffee nerves holding together a few frowsy integrals . . .

So you cast around for some form of escape. Heroin is out, reefers too expensive. You pick up the ENGINEER, eagerly devour Stress and Strain and what do you get? Clean jokes. You waste two bits on the *Widow,* and what do you get? Inane diatribes about the exterior ornaments of Lincoln Hall, God bless its crusty old bricks and picturesque clocks. You drink whiskey . . . go broke. You drink beer . . . a hangover. You make friends with a stray dog . . . he snaps at your slide rule. You take out a coed . . . and don't get a word in edgewise all night, because she is so busy raving about what poor conversationalists the engineers are.

A guy could be discouraged if it weren't for things like Prof. Grantham throwing that pendulum at his chin year after year, and Prof. Cuykendall insisting in mechanics that "Every couple has its moment."

* * *

Young Sitzfleisch got a job in a shipyard. The first morning the foreman gave him a two-foot rule and told him to go measure a large steel plate. Sitzfleisch returned in twenty minutes. "Well," inquired the foreman, "what's the size?"

The M.E. displayed a satisfied grin. "It's just the length of this rule," he said, "and two thumbs over, with this brick, and my arm from here to here, bar the fingernails."

* * *

Foreigners visiting America are often confused by our parlance. One Chinese lad stated, "Funny people these Americans. They take a glass. They put sugar in a drink to make it sweet and lemon to make it sour. They put in gin to make it warm and ice to make it cold. Then when the thing is finished they say, 'Here's to you,' and drink it themselves."

## Definitions—1221

For the benefit of those frosh who may not have been told these items by doting parents, we reproduce below one of the oldest engineering college aphorisms. This information was first found in a copy of "Elements of Bathtub Analysis" by Archimedes Sitzfleisch, BC 500.

### The Faculty

*Instructor*:
Bewildered young engineering graduate unable to succeed in industry. Usually young enough to be found in the Straight after class. Stutters frequently as he is only one chapter ahead of the class. Intends desperately to get a doctor's degree. Call him "sir" if you want a good mark.

*Assistant Professor*:
A promoted instructor. Promoted when his speech finally became completely unintelligible. Wears ASME key he found in Sibley Libe. Has started to write textbook. Thinks that with a little influence and more rigorous attendance at seminars that he might be able to get a doctor's. Call him "Professor" to maintain high standing.

*Associate Professor*:
Originator of the working-my-way-through-school racket. Sells his own textbooks instead of magazines. Call him Doctor if you want to pass.

*Professor*:
Can recite lectures backwards or forwards; occasionally does both simultaneously. Wishes he had a fortune instead of a Doctor's degree.

* * *

"What is the difference between an Eco major and an Engineer?"

"An engineer is a damn fool runing around with a slide-rule, but an eco major doesn't own a slide-rule."

* * *

It seems amazing to us that even a normal, intelligent engineer tracks all these crazy and uninspiring little triangles right down to the very bitter revolting end.

# Alumni News

**Charles P. Gross, M.E. '21,** formerly Chairman of the Board of Transportation of the City of New York, retired from that position on October 21, 1947.

**A. G. (Gil) Laas, M.E. '23,** has been named executive engineer of the Studebaker Corporation, South Bend, Indiana.

**George M. Trefts, M.E. '27,** Vice-President of Farrar and Trefts, Inc., Buffalo, N.Y., was recently elected vice-president of District 1 of the American Welding Society. In the time since Mr. Trefts has been associated with Farrar and Trefts, the plant product has shifted from almost all riveted work to almost all welded work.

**James T. Lewis, M.E. '27,** president and general manager of the Lewis Welding and Engineering Corporation, Bedford, Ohio, has been granted the first welderies classification award of $3,200 in the design-for-progress program sponsored by the James T. Lincoln Arc Welding Foundation of Cleveland, Ohio.

**Miss Olive Dennis, C.E. '30,** named by Carrie Chapman Catt in 1940 as one of the nation's one-hundred outstanding career women, is currently engaged in post-war railroad car planning for the B. & O. Railroad, Baltimore, Md.

**Victor K. Hendricks, Ch.E. '33,** is with Max B. Miller and Company, Refinery Engineers, in New York City.

**Robert J. Fritz, B.Ch.E. '43,** is with the Standard Oil Development Company, Elizabeth, N.J., doing research and development work on fuels and combustion.

**H. R. Buchanan, B.S.Ch.E. '43,** is with the Celanese Chemical Corp., in New York City.

**Dick P. Klopp, B.S.Ch.E. '43,** is a chemical engineer with the Texas Corporation at Lawrenceville, Illinois.

**Carl Ching-te Wu, B.S. in M.E. '43,** is attending the Graduate School of Harvard University under the terms of a Rotary Fellowship awarded him last June. Mr. Wu, a native of China, came to Cornell in 1939 to major in machine design and metal processing.

**Ray C. Baxter, B.Ch.E. '44,** formerly with the Standard Oil Company in Indiana, is now with the Solvay Process Co., in Syracuse, N.Y.

**Robert L. Simonds, B.S.Ch.E. '44,** is with the Goodyear Tire and Rubber Company, Akron, Ohio.

**Robert H. Olsen, B.Ch.E. '46,** is with the Solvay Process Company, Syracuse, New York.

**Kenneth W. Olsen, B.Ch.E. '47,** is now employed by the Casein Company at their plant in Bainbridge, N.Y.

**James Gillin, Jr. B.Ch.E. '47,** is now doing graduate work in the School of Chemical Engineering.

**DIED**

**John M. Young, M.E. '02,** M.M.E. '04, president of Pacific Engineering Co. and professor emeritus of engineering at the University of Hawaii. In 1908, he moved to Hawaii and had lived there since.

**Edward Holmes, C.E. '05,** executive of Progressive Building and Loan Association, Washington, D.C., on September 1, 1947. He was a former director of the Cornell Alumni Corp. and past president of the Cornell Club of St. Louis, Mo.

## Jersey Group Meets

On November 18th the New Jersey Regional Group of the Cornell Society of Engineers held a dinner meeting at the Robert Treat Hotel, Newark, New Jersey. Sixty members were present.

Mr. Karl Nelson served as chairman. Dean S. C. Hollister was the principal speaker. He gave a review of the changes that have taken place in the College of Engineering during the ten years he has been Dean, as well as his opinion of what the future holds in store. A question and discussion period followed.

The next meeting of the New Jersey Regional Group is scheduled for the spring, at which time the officers for 1948-49 will be elected.

## ATTENTION, ALUMNUS !

This is your column. We, as undergraduates, are only concerned here in the assembling of information of interest to you and your fellow Cornell engineering alumni. We realize then, with our limited source of such news, that this section is not a complete summary of all the important and interesting alumni news. With your interest and cooperation, we hope to improve the situation by the addition of alumni contributions. These, we feel, would awaken this column to an accurate representation of the engineering alumni. You, as a contributor, do not have to possess first-hand dope on J. Doe '25 and his recently acquired vice-presidency; any opinions, ideas, photographs, or information of any interest at all to Cornellians will be welcome. Through such an arrangement, this column could become a monthly reunion for Cornell engineers. Why not make it a point to write us, even if it's just to say "hello"?

Just address the—

Alumni Editor,
The Cornell Engineer
Cornell University
Ithaca, N. Y.

## Techni-Briefs

(*Continued from page 20*)

Then by placing in the remaining two holders certain standardized alloys containing predetermined amounts of the metallic component and taking readings with the counter and comparing these readings with a calibration table, quantitative determination of the composition of the alloy may be made.

### Aircraft Icing

Icing on aircraft, long a problem of flying under overcast conditions, has been brought more nearly under control through the results of experiments carried on under "Project Cirrus," weather research program of General Electric in collaboration with the Signal Corps, the Office of Naval Research and the Air Force.

Icing is produced by the crystallization of supercooled water droplets on the wings of an airplane passing through an "icing" cloud which cause enough disturbance to upset temporarily the state of unstable equilibrium present. Now, if these clouds of moisture at temperatures far below freezing could be caused to crystallize through the action of some foreign substance, the area would be safe for the passage of planes—an essential factor in taking off from or landing at a field under such conditions. This is exactly what has been accomplished by GE in their experiments under "Project Cirrus." A super-saturated or super-cooled cloud can be seeded to form either snow or rain by the distribution of dry-ice pellets through the area. These crystals immediately cause crystallization to take place and an amount as small as 25 pounds will clear up an area of 150 square miles within an hour's time.

Other results from this method that are expected to be of benefit will be the seeding of supersaturated storm-clouds to prevent sudden disastrous thundershowers or hailstorms. If these clouds are seeded near their peaks, a somewhat longer, but much milder storm can be brought about. Dr. Irving Langmuir, associate director of the GE research lab, states that in the future it may also be possible to aid in the irrigation of dry areas, to decrease the cloudiness during winter months, etc., through this process.

### Open-Hearth Steel

Oxygen is now being used by the steel industry to promote chemical reactions in the open-hearth process and to speed up the production of steel. Beside using oxygen in the open-hearth flame, thereby increasing its temperature and speeding up the melting of raw materials, it is bubbled into the molten steel in the furnace to speed up the rate at which the refining reactions take place. About 85 per cent of the steel made in the United States comes from the open-hearth furnaces; and over the years the size of furnaces has been increased from 10 tons capacity to 200 tons and the time to manufacture a heat of steel has been reduced from 20 hours to 10 hours. The use of oxygen will make possible ever greater advances.

### Versatile Heater

A hot-water heater which will air-condition and de-humidify your home in the bargain is in store for the public, according to experiments being carried on by the Hotpoint division of General Electric.

(*More brief news on page 26*)

# Cornell Society of Engineers

107 EAST 48TH STREET 1947-1948 NEW YORK 17, N. Y.

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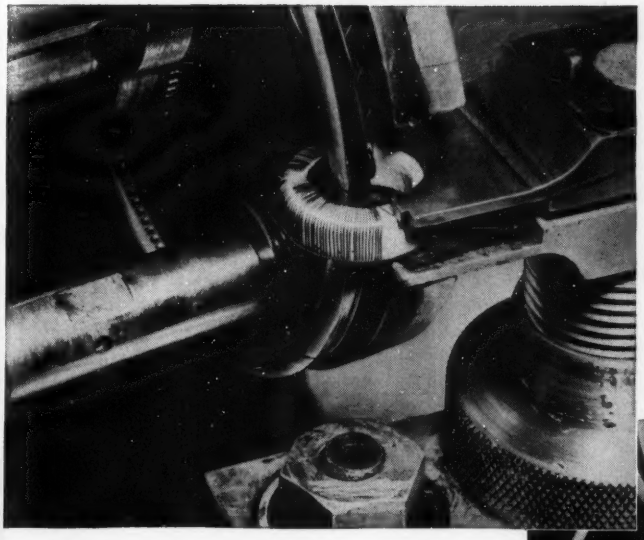
*"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates and former students and to establish a closer relationship between the college and the alumni."*

Carl F. Ostergren

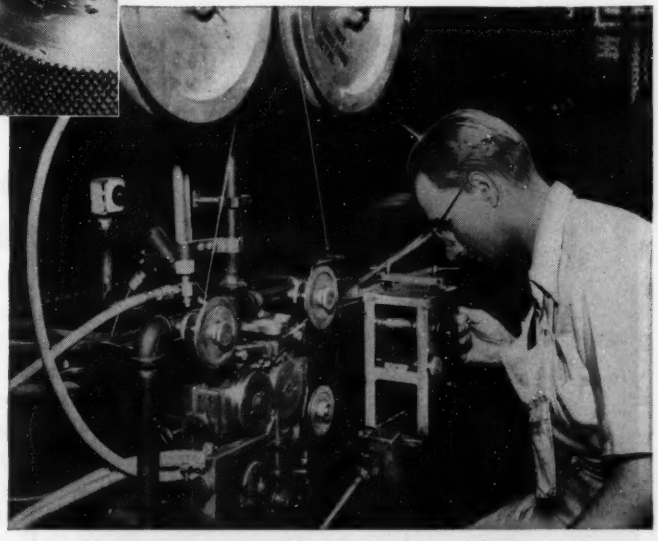
NUMBER 9 OF A SERIES

# Newsworthy Notes for Engineers



## Winding wire on a "wedding ring"

This is the "Sea Breeze," a machine developed by Western Electric engineers. It solves the problem of winding wire half the thickness of a human hair on a toroidal core the size of a wedding ring. Compressed air drives the flyer which maintains the wire under positive tension at all times, winding as many as 40,000 turns of #46 wire on the core. It winds finer wire than any previous machine, lays turns more uniformly, winds a wider range of wire sizes, increases efficiency in utilization of winding space and permits the manufacture of coils half the size of those previously possible.



## Metal welding that saves millions

Here, palladium and nickel tape are welded together at the rate of 400 feet an hour. Tiny bars are later snipped from this bi-metal tape and used to replace the precious pinhead-size platinum rivets once used as contacts in Bell System relays. These contacts, which minimize noise in telephone conversation, are used by the billions in relays that perform switching operations. The use of this bi-metal tape... devised by Bell Telephone Laboratories scientists and produced on machines developed by Western Electric engineers ... saves millions of dollars a year in the cost of producing telephone equipment.

**Engineering problems** *are many and varied at Western Electric, where manufacturing telephone and radio apparatus for the Bell System is the primary job. Engineers of many kinds—electrical, mechanical, industrial, chemical, metallurgical—are constantly working to devise and improve machines and processes for mass production of highest quality communications equipment.*

**Western Electric**

**A UNIT OF THE BELL SYSTEM SINCE 1882**

## Techni-Briefs

(*Continued from page* 24)

The apparatus works on the principle of the heat engine with heat being taken from the air as the "hot body" and being transferred to the water as the "cold body." Di-fluoro-di-chloromethane, better known as "freon," is the medium for this transfer of heat. This gas is contained first at room temperature in the evaporator which comprises a series of coils very similar to those in a refrigerator. A compression pump is then put to work, causing the temperature of the freon to rise rapidly. The hot gas is then conducted to coils within the water tank where it condenses on contact and gives up most of its heat content to the water. The freon is then allowed to flow back to the evaporator where it returns to room temperature taking heat from the surrounding air and incidentally dehumidifying that air by causing the moisture in it to condense. At present the unit is not ready for use by the general public, but when it is put on general sale, GE engineers estimate that it will reduce the average yearly electric heater bill to one-quarter of the present figure.

### Color Photography

The production of separation negatives for color printing processes will be facilitated in the future by the use of a new sheet film produced by the Du Pont Company. This film, known as "S-T Tripac" brings to color photography some of the simplicity of black-and-white work in that it may be used in ordinary plate-back cameras and does not necessitate special equipment. The film is composed of three emulsion layers and two supports—the first two layers of which are attached to the first support and record blue and green and the last of which is attached to the rear base and records red. Processing this film to obtain the requisite separation negatives involves transferring the green emulsion layer to another base and when that is done, the negatives may be produced with a minimum of expense and effort.

### Titanium

Titanium has been found most useful in keeping metals from getting "tired." When a piece of iron,

(*More brief news on page* 28)

*Use the* CORNELL UNIVERSITY PLACEMENT SERVICE

**Administration Building, Ithaca**
John L. Munschauer '40, Director

**New York Office, 107 E. 48th St.**
Paul O. Reyneau '13, Manager

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*At RCA Exhibition Hall, radio, television, and electronics are on parade in fascinating new exhibits*

## *"World's Fair" of radio-electronic wonders... RCA Exhibition Hall*

**100,000 visitors every month**—that's how people have responded to the exciting new RCA Exhibition Hall in Radio City.

Like a "World's Fair," this is a place where you can watch, and even operate, many recent developments of RCA Laboratories. Television, radio, loran, the electron microscope, and other scientific achievements . . . you'll find them "on show," fully explained, and thrilling to see.

For instance: step on a platform and televise yourself, see yourself in action on a real television screen. Watch radio waves heat steel red-hot in a jiffy. Hear the newest RCA Victor recordings. Take home a souvenir message from globe-encircling RCA Communications—see Radiomarine's radar and learn exactly how the NBC Network operates to bring its "Parade of Stars" to your home.

Conveniently located in the heart of Radio City—at 40 West 49th Street—RCA Exhibition Hall is open 11 a.m. to 9 p.m. daily; everyone is welcome, there is no admission charge. *Radio Corporation of America, RCA Building, Radio City, New York 20, N. Y.*

**Continue your education with pay—at RCA**

**Graduate Electrical Engineers:** RCA Victor—one of the world's foremost manufacturers of radio and electronic products—offers you opportunity to gain valuable, well-rounded training and experience at a good salary with opportunities for advancement. Here are only five of the many projects which offer unusual promise:

- Development and design of radio receivers (including broadcast, short wave and FM circuits, television, and phonograph combinations).
- Advanced development and design of AM and FM broadcast transmitters, R-F induction heating, mobile communications equipment, relay systems.
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**Also many opportunities for Mechanical and Chemical Engineers and Physicists.**

RCA **RADIO CORPORATION of AMERICA**

**WHY GIVE WIRES AND CABLES A.C. AND D.C. TESTS?**

At Okonite regular d.c. tests pick out imperfections in insulated wires and cables not detected by conventional methods. These d.c. tests, at 4 times the a.c. values, are in addition to the routine high voltage tests.

"Something extra" is typical of Okonite production techniques and research procedures. That something extra, multiplied many times spells leadership . . . reflects Okonite's engineering background as pioneers in electrical wires and cables. The Okonite Company, Passaic, New Jersey.

OKONITE SINCE 1878 5131

insulated wires and cables

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A Regents School where aim is to prepare students for University work.

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Tutoring in university courses that is effective because directed to individual needs.

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DIAL 2014 ITHACA, NEW YORK

MAXWELL T. KENDALL '36, *Headmaster*

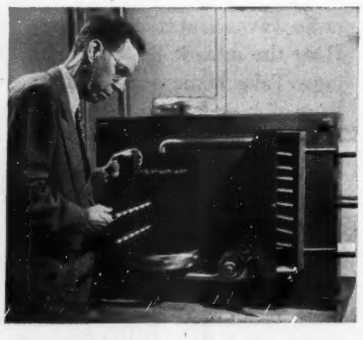
## Techni-Briefs

(*Continued from page* 26)

like a wire paper clip, is bent many times, it gets "tired" and finally breaks with about half the stress required to break it when the metal is fresh. By alloying the iron with some other metals it tires much less quickly. It has been found that molybdenum, silicon, manganese, nickel, cobalt, and chromium are effective in improving the fatigue strength of iron, but titanium has been discovered to be the most effective.

### Atomic Plant

A new advance in the field of the application of atomic energy to commercial fields has been recorded by the GE Research Lab by the construction of a model atomic power plant. According to this model, the "pile" with control rods to hold down the reaction would be set up in one section, a heat exchange fluid would be pumped through the pile and thence to another heat exchanger where water would be turned to steam to run a turbine. In order to prevent any dangerous effects from the radioactivity of the system, both the pile and the heat-exchange fluid circulation would have to be shielded by concrete or some similar material. The big problem still remaining, however, is the elimination of the waste materials so that they can do no harm in their dangerously radioactive state. Many methods of disposal have been discussed including dumping in the ocean, burying in unused caves, etc., but so far all have proved to be faulty.



**Dr. Kenneth H. Kingston of the GE Research Laboratory with a model of a proposed atomic power plant. The model has all the basic elements built to scale.**

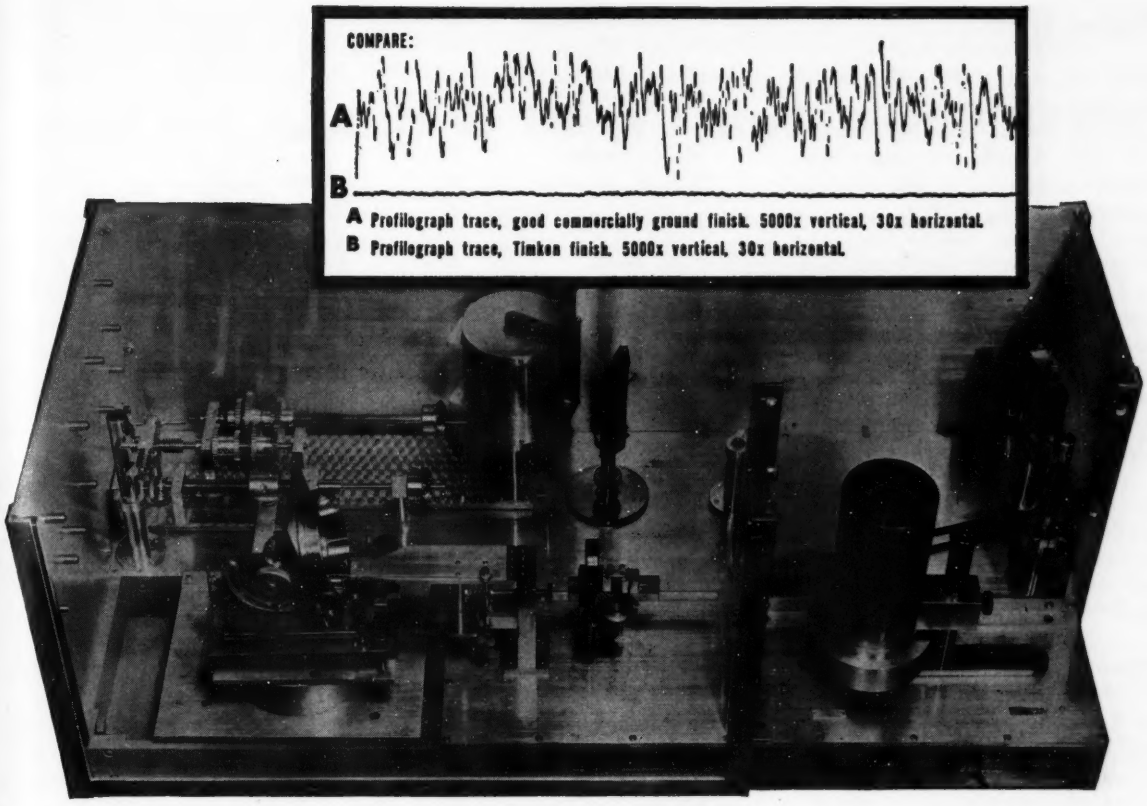
### Germ Killer

A new germicidal unit that will destroy airborne bacteria in as little as eight seconds has been announced by the Duro-Test Corp. This new unit will be able to kill both airborne bacteria through indirect radiation and to destroy molds, bacteria virus and fungus through direct radiation on the substance. Used indirectly and mounted at eye level, the germ killing unit will have a wide variety of uses for purifying air in schools, hospitals, homes, and other public gathering places. Used indirectly it will have varied uses in the food industries and businesses.

### Neoprene Lures

Combining extreme realism and durability are new life-like fishing lures made of neoprene. These artificial "bugs"—crickets, grasshop-

(*Concluded on page* 30)


COMPARE:
A
B
A Profilograph trace, good commercially ground finish. 5000x vertical, 30x horizontal.
B Profilograph trace, Timken finish. 5000x vertical, 30x horizontal.

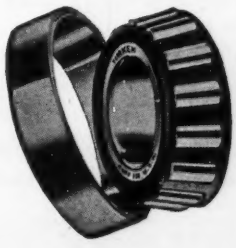
# Answers the question— "How rough is smooth?"

ONE of the reasons Timken Tapered Roller Bearings perform with such frictionless, wear-free ease is the amazingly smooth surface finish on the rolls and races —the finest known to modern bearing science.

Now, when you talk about finishes like this, you're talking about surface irregularities of only a few millionths of an inch — irregularities which are impossible to detect by any ordinary means. So, when Timken first began to develop this finish, one of the biggest obstacles was the absence of an accurate method of measuring the roughness of an apparently smooth surface.

The profilograph pictured above was the answer. Developed by Timken in 1928 and steadily improved since then, the profilograph determines surface irregularities to within one-millionth of an inch. Equipped with this measuring stick, Timken engineers were able to develop new finishing methods and machines, which have resulted in the microscopic surface accuracy of the Timken Bearings you use today.

Every factor in the efficiency of a bearing is approached at Timken in this same scientific manner. For example, Timken makes its own steel to assure constant quality. And Timken is the acknowledged leader in: 1. advanced design; 2. precision manufacture; 3. rigid quality control; 4. special analysis steels. No wonder you can always be sure of uniformly top quality and performance in the Timken Bearings you use. The Timken Roller Bearing Company, Canton 6, Ohio.



**TIMKEN**

TRADE-MARK REG. U. S. PAT. OFF.

**TAPERED ROLLER BEARINGS**

## Techni-Briefs

(*Concluded from page* 28)

pers and stone flies—give the fly cast the advantage of life-like bait with the ease of handling of artificial flies. All the new lures have flexible, hollow bodies, making them easier to handle with no interference when the fish strikes. The first of these lures were made back in 1939. The process was developed slowly as a hobby until, in the spring of 1945, these imitation insects were first made cheaply enough to be sold commercially.

## College News

(*Continued from page* 17)

ber of the organization showing the highest scholastic average in his freshman and sophomore years was given to Leo Sears '50, of Hackensack, N.J.

### Atmos

New members elected this term to Atmos, the mechanical engineering honorary society, are:

| | |
|---|---|
| Jack Cullen | '48 |
| Carl Harrison | '48 |
| Charles Mershon | '48 |
| Hillary Micou | '49 |
| Daniel McCarthy | '49 |
| Harry Rice | '49 |
| John Snedaker | '49 |
| Philip Snyder | '48 |
| William Thomas | '48 |
| Charles VonWrangell | '48 |
| David Woodworth | '49 |
| Ross Worn | '49 |

### Chi Epsilon

The civil engineering honorary society, Chi Epsilon, has elected fifteen new members this term. They are:

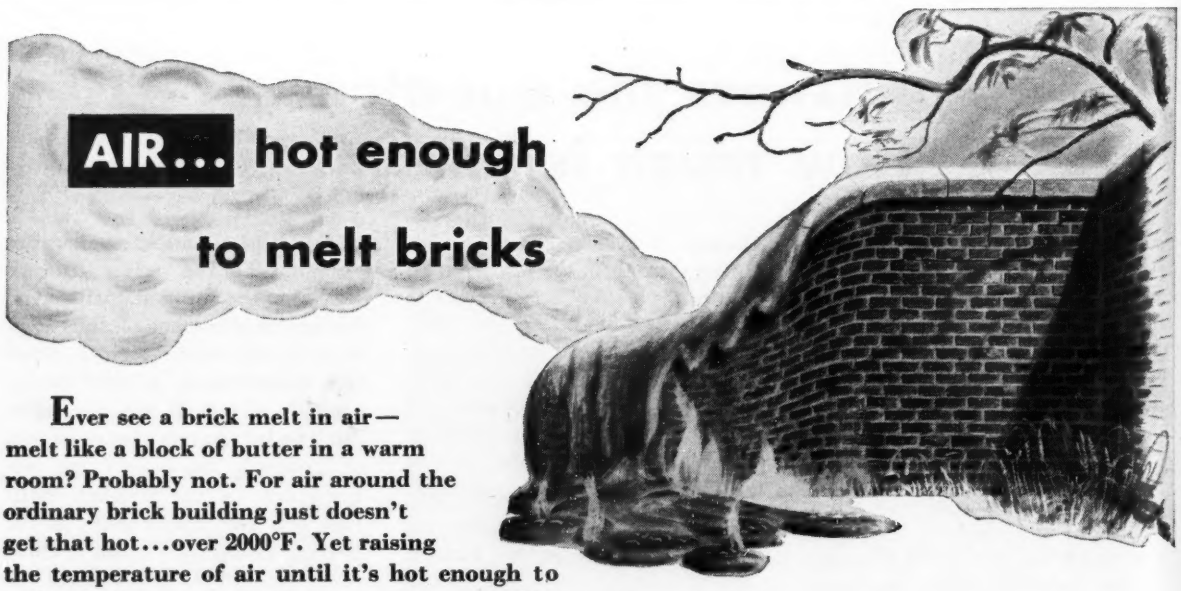
| | |
|---|---|
| Joseph W. Burdell Jr. | '49 |
| Roger S. Chapman | '49 |
| David L. Cownie Jr. | '49 |
| Joseph W. Dawson | '49 |
| Faith E. Gregory | '48 |
| William L. Hewitt | '48 |
| Wendel F. Kent | '49 |
| William W. Langhorst | '49 |
| Edward E. Lewis | '49 |
| Homer S. Lundy | '49 |
| Russell N. Meyer | '49 |
| Volney A. Plumb | '49 |
| James W. Spencer | '49 |
| John D. Ten Hagen | '49 |
| William Wade | '49 |

### Foundry Scholarships

Scholarships have been awarded to five freshmen and five sophomores in conjunction with the foundry industry to develop future engineering management in that field. The award is part of a three year, $57,000 program, sponsored by the Foundry Educational Foundation. Renewable and worth $600 per year, the scholarships will go to engineering students, who will work in the foundry field during summers and choose a foundry project or thesis for their degree work. The recipients named this term are:

William H. Arnold, Washington, D.C.
Robert J. Lehren, Riverside, Conn.
Alfred Ricciardo, Leonardo, N.J.
Henry Robinson, Akron, Ohio.
Paul Widener, Conesius, N.Y.
Robert Folkman. Warren, Pa.

(*More news on page* 32)


**Ever see a brick melt in air—melt like a block of butter in a warm room? Probably not. For air around the ordinary brick building just doesn't get that hot...over 2000°F. Yet raising the temperature of air until it's hot enough to melt a brick — and a lot hotter — is now possible with the Pebble Heat Exchanger developed by B&W. It heats gases far above the temperature limits of metallic heat exchangers.**

**Development of the Pebble Heat Exchanger is further evidence that B&W—old in experience, pioneer of many advances in divergent fields—is still young enough to have new ideas.**

**B&W offers excellent career opportunities to technical graduates in diversified phases of manufacturing, engineering, research, and sales.**

N-30

**THE BABCOCK & WILCOX CO.** 85 LIBERTY STREET, NEW YORK 6, N. Y.

# WHY THE TREND IS TO Mo HIGH SPEED STEELS

Why do makers—and users—of metal-working tools go strong for molybdenum high speed steels?

Performance is one answer. In actual operation, in the form of twist drills, hacksaw blades, milling cutters, lathe bits and many other tools, molybdenum steels have proved that they outperform 18-4-1. They work longer between grinds, and they have longer over-all life.*

Cost is another answer. Molybdenum steels cost from 10¢ to 20¢ a pound less than 18-4-1, and they provide more tools per pound of steel because their density is 6% to 9% lower.

Many of the country's largest users of high speed steels have standardized on molybdenum steels. They have done it because they know that the use of these modern steels lowers production costs.

*Our booklet on molybdenum high speed steels will give you proof of these statements. Write for it.

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CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

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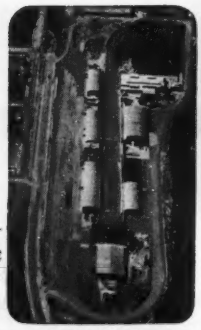


43-Acre Plant from the Air

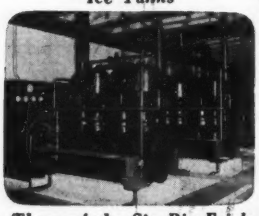
FRICK Refrigeration

**To Make 600 Tons of Ice a Day for California Shippers**

That's the projected output at Salinas, where the Shippers Development Co. has built a $1,400,000 plant to ice vegetables. Five big growers and packers use the product for icing thousands of railway cars and trucks. The Associated Refrigerating Engineers, of Los Angeles, selected Frick equipment for this important job. You, too, will find Frick refrigerating, ice-making, and air conditioning systems most reliable and profitable.

*The Frick Graduate Training Course in Refrigeration and Air Conditioning, now in its 31st year, is approved under the G. I. Bills of Rights.*

*Group Lift Saves Labor on Ice Tanks*



*Three of the Six Big Frick Machines*

FRICK CO. WAYNESBORO, PENNA.

***Do You Know That:***
***Midget Pocket Slide-Rules Are Back?***

Post's 5-inch Rule (with leather case) ....$5.50
K. & E. Pocket Rule (with leather case)....$5.75
(with Folded C and D Scales) .....$6.50

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The Engineer's Mathematical Wall Chart will solve your problems. It has Strength and Mechanics Formulae, Fundamental Integrals, Trig Functions, etc. Only .....$.35

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**In Your Leisure (?) Hours**

You will want to sit back, relax, and listen to one of the new 1948 Emerson radios. The latest is the new 3-way AC-DC-Portable in a simulated Alligator case. .....$29.95

TRIANGLE BOOK CO-OP

**EVAN J. MORRIS, Prop.**
Sheldon Court—Open 8 A.M. to 8 P.M. Phone 2304


## College News

(*Continued from page* 30)

William C. Hagel, Pittsburgh, Pa.
Jerome M. Jenkins, Bronxville, N.Y.
Albert P. Oot, Syracuse, N.Y.
Nicholas Sheptak, Bronxville, N.Y.

## Instrumentation Course

This term the School of Chemical and Metallurgical Engineering is offering a course in Instrumentation with special reference to the applications of instrumental methods of measurement and control in the chemical industries.

The first group of lectures, on the general principles of instrumentation, is given by Professor Rhodes. Following this introduction is a series of groups of lectures. Each group consists of five one-hour lectures on consecutive days from Monday through Friday, and is given by a representative from a company that manufactures industrial instruments or that uses such instruments extensively. The lecturers are:

Mr. Kermit Fischer—Fischer and Porter Co. — Variable-Area Flow Meters
Mr. R. C. Machler—Leeds and Northrup Co. — Temperature Measurement and Control
Mr. M. J. Ladden and Mr. K. W. Roberts—The Brown Instrument Co. — Pyrometry and Automatic Control
Mr. E. L. Stilson—The Bristol Co. — Applications of Instrument Control in Industry
——— Taylor Instrument Companies—Design and Application of Air-Operated Instruments
Mr. L. K. Spink—The Foxboro Co.—Electronic Measurement
Mr. H. F. Moore—Standard Oil Development Co. — Use of Automatic Control in Petroleum Industry

The course is intended primarily for advanced and graduate students in Chemical Engineering but is open to qualified students from any division of the University.

## Jerome Schwarzkopf

(*Concluded from page* 18)

engineer." But even so, a small amount of design work did come his way.

Besides plain everyday loafing, Jerry is also interested in scale model railroading. He and his brother have an HO-system layout at home, which always seems to require something in the way of time and work. Jerry also has a flying license, which resulted from a course in the Navy. At Cornell, dorm bull sessions are an integral part of Jerry's life. He also enjoys the crew trips with the good spirit of rivalry present, and the trip to Penn last year was "tops."

On graduating in February with a B.E.E., Jerry intends to work in the high frequency and microwave field of radio. Outside of that, he is undecided about his future job and open to any offers. At some time in the distant future, he may go into business or patrnership in some field relating to electrical engineering.

# *Barr and Lane, Inc.*

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NEW YORK

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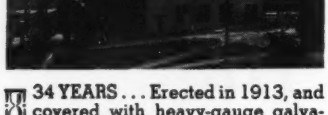
ITHACA, N. Y.

# TIME
## PROVES
**Galvanized (ZINC-COATED) Sheets**
**Stay Stronger Longer**

34 YEARS . . . Erected in 1913, and covered with heavy-gauge galvanized sheets, this Tennessee concentrating plant of the A/Z Company, is still in excellent condition after *more than 3 decades of service.* Painted with Gray Metallic Zinc Paint in 1932.



In building for the future, look to the past for proof of a building material's strength . . . durability . . . service. With galvanized (zinc-coated) roofing and siding, you get the strength of steel . . . the rust protection of Zinc. So for low-cost, long-time service, choose the building material that's proved by TIME itself . . . galvanized sheets. Send coupon for information about Zinc and how it can help keep your buildings and equipment stronger longer.

ZINC INSTITUTE 2 OZ. COATING SEAL OF QUALITY

This "Seal of Quality" is your guide to economy in buying galvanized sheets. It means they carry at least 2 oz. of Zinc per sq. ft.

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## FREE BOOKLETS!

Send me without cost or obligation the illustrated booklets I have checked.

- ☐ Repair Manual on Galvanized Roofing and Siding
- ☐ Facts about Galvanized Sheets
- ☐ Use of Metallic Zinc Paint to Protect Metal Surfaces

Name_____

Address_____

Town_____ State_____


## Athens Water Supply

(*Continued from page 9*)

tunnel was by way of the drainage tunnel. The rising waters of the lake were blocked out of the tunnel by a bulkhead between the gate chamber and the portal. Before putting the tunnel in service a bulkhead was constructed in the tunnel on the south side of the gate chamber.

The capacity of the Boyati Tunnel is ample to take care of any additions to the supply.

(5) *The Drainage Tunnel* as originally constructed, had a cross section the same as the Boyati Tunnel. It was primarily designed to form a means of access to the Boyati Tunnel. The tunnel was also available for drawing water from the main tunnel for purposes of inspection or otherwise. It was extensively used while making hydrostatic tests on the Boyati Tunnel before putting it in service. An inner concrete lining was finally constructed inside the concrete block lining to prevent water seeping into it from the reservoir.

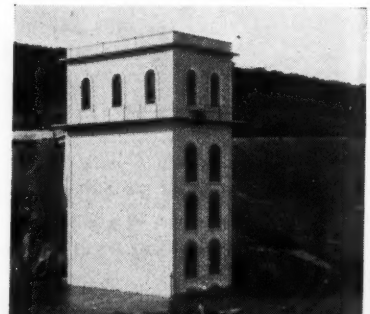
(6) *The Helidonou Tunnel* is entirely under the Attica Plain, at a shallow depth and is also lined with concrete blocks. It is smaller in cross section than the Boyati Tunnel, but if necessary a parallel auxiliary tunnel can be built at small expense.

(7) *The Athens Siphon* is a cast iron pipe about four miles long. The writer understands that a parallel line was constructed some years later.

(8) *The rapid sand filtration plant* is a completely modern plant, but the water delivered from Marathon Lake is of such purity that there is hardly any need for filtration. To avoid complaints from those who had been insisting on spring water, the filtration plant was included in the project.

(9) *The Middle Service Reservoir* is located close to the filtration plant. It also serves as a clear water reservoir for the filtered water. There are two basins, each with a capacity of 41,000 cubic meters. This reservoir is the main service reservoir of the system.

(10) *The distribution system* involved the installation of no less than 860 kilometers (535 miles) of pipe. Very little of the area of the city had been connected with the old Hadrian system and few of the old pipes were used. The new system was based on an average supply of 100 liters per day per capita and 150 liters maximum. All water services are carefully metered as otherwise it is quite certain that at no time would there be enough water to fill the minimum needs of the populace.



**Built as a replica of the Treasury of Ancient Athens is this gate house at the base of Marathon Dam. Through it the quantity of water flowing in Boyati Tunnel is controlled.**

(11) *The Stamata Dam and Tunnel* was an economical project for obtaining most of the flow of Stamata Creek, a small stream having a watershed on the slopes of Mount Pentelicon. The slope of the bed of the creek is so steep that the dam serves only for diverting into the tunnel part of the runoff. The Stamata Tunnel is also lined with concrete blocks and delivers water into the Marathon Reservoir.

### Colorful Opening

In June, 1931, the new system was ready to deliver water, although there were still some details to finish. The inauguration

(*Concluded on page 36*)

DU PONT Digest
For Students of Science and Engineering

# Rubber accelerators lead the way to new agricultural fungicides

Vulcanization accelerators for rubber and agricultural fungicides would seem to have little in common. But the wide variety of interests of men in the Du Pont organization sometimes result in outstanding developments from such apparently unrelated products.

A rubber chemist suggested to a plant pathologist that derivatives of dithiocarbamic acid, $NH_2$-C(S)SH, parent substance of a well-known group of rubber accelerators, be tested as insecticides. His suggestion was based on the possibility that sulfur combined in this form might be more effective than free sulfur, a recognized insecticide.

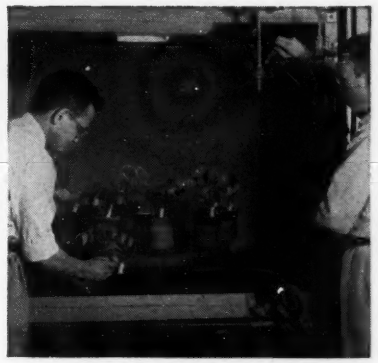
Entomologists and plant pathologists investigated the fungicidal as well as the insecticidal properties of this group. One of the first compounds tested, sodium dimethyldithiocarbamate, $(CH_3)_2$N-C(S)SNa, even in dilutions of 1:30,000, was found to be a powerful fungicide, but somewhat injurious to plant life.

This led to a systematic program of research including other metallic salts, the ethyl, propyl, butyl, phenyl, and other aryl derivatives of the dithiocarbamates and thiuram mono- and disulfides, and the related compounds made from ethylenediamine and morpholine. In this phase of the work, organic chemists played an important role by suggesting various derivatives and preparing them for tests. Later, in cases where proper dispersion and adherence of the compounds to plants were important, the skill of physical chemists was called upon.

In general, the compounds of greater chemical stability were found to be less effective. Fungicidal efficiency diminished with increase in size of alkyl radical, and as aryl radicals were substituted for alkyl. Thus the unusual situation developed that with the exception of the bisethylene (dithiocarbamates), the first and simplest products tested, the methyl derivatives, proved to be the best fungicides.

Iron and zinc dimethyldithiocarbamates, $(CH_3)_2$NC(S)-S-M-S-(S)CN $(CH_3)_2$, are now sold as "Fermate" fungicide and "Zerlate" fungicide respectively, for control of fungous diseases of many fruit and vegetable crops, tobacco, flowers and other ornamentals. Zinc ethylenebis(dithiocarbamate), Zn(-SC(S)NHCH$_2$CH$_2$NH(S)CS-), marketed as "Parzate" fungicide, has specific action in the control of late blight on potatoes and tomatoes. Tetramethylthiuram disulfide, $(CH_3)_2$NC(S)-S-S-C(S)N$(CH_3)_2$, is used in two compositions, as "Arasan" disinfectant for seeds and "Tersan" fungicide for turf diseases.

Overall, the derivatives of these groups of compounds proved to be outstanding as fungicides, rather than as insecticides. Although a marked degree of specificity for different pests was characteristic of the members of this series, it is interesting to note that all three were highly effective. This work offers still another example of how the breadth of interest in a company like Du Pont can lead to worthwhile developments.



B. L. Richards, Jr. Ph.D., Cornell '44, and A. H. Goddin, M.S., University of West Virginia '32, test efficiency of "Parzate" fungicide in control of tomato late blight and bean rust. Equipment is specially designed laboratory spray chamber.

Field testing of promising fungicides, including "Parzate" formulations, for control of tomato late blight.

**Questions College Men ask about working with Du Pont**

**What are the opportunities for research men?**

Men qualified for fundamental or applied research are offered unusual opportunities in facilities and funds. Investigations in the fields of organic, inorganic and physical chemistry, biology, parasitology, plant pathology and engineering suggest the wide range of activities. Write for booklet, "The Du Pont Company and the College Graduate," 2521-A Nemours Building, Wilmington 98, Delaware.

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...THROUGH CHEMISTRY

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To Serve Many Industries in Many Fields

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Grinding wheels of ALUNDUM*, CRYSTOLON* and diamond abrasives; discs and segments; bricks, sticks and hones; mounted points; abrasives for polishing, lapping, tumbling and pressure blasting; pulpstones.

**Grinding and Lapping Machines**

A varied line of machines for production-precision grinding and lapping and for the tool room — including special machines for crankshafts, camshafts, rolls and car wheels.

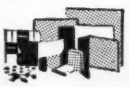
**Refractories**

High temperature refractories—grain, cement, bricks, plates, tile, tubes — for metal melting, heat treating and enameling; for ceramic kilns; for boiler furnaces and gas generators; for chemical processes; refractory laboratory ware; catalyst carriers; porous plates and tubes.

**Norbide***

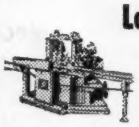
Trade-mark for Norton Boron Carbide — the hardest material made by man. Available as an abrasive for grinding and lapping; in molded products for extreme resistance to wear — especially effective for precision gage anvils and contact points; and for metallurgical use.

**Norton Floors**



ALUNDUM* Floor and Stair Tile, ALUNDUM* Ceramic Mosaic Tile and ALUNDUM* Aggregates to provide permanently non-slip (wet or dry) and extremely wear-resisting floor and stair surfaces.

**Labeling Machines**



Single and duplex automatic labeling machines for applying labels and foil to beverage bottles and food, cosmetic and drug containers.

**Oilstones and Coated Abrasives**

Sharpening stones and abrasive papers and cloth for every use of industry and the home craftsman. Products of the Norton Behr-Manning Division, Troy, New York.

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## Athens Water Supply

(*Concluded from page* 34)

of the new system was a public ceremony and the cause of much rejoicing after so many years of waiting. The most spectacular feature of the celebration was a large temporary fountain erected on the grounds of the ancient and ruined Temple of Zeus. The religious ceremony conducted by the clergy of the Greek Orthodox Church was very impressive. At a given signal the valve controlling the water for the fountain was opened by the Prime Minister and the water gushed forth; the system was officially in use.

---

## Protective Coatings

(*Continued from page* 15)

particularly resistant in the presence of food acids and other metal deteriorants. The addition of dioctyl phthalate as a plasticizer yields an organosol whose low viscosity aids in the quick application of a relatively thick film, and by high temperature baking some fine products of high solids content have been prepared. Their lack of toxicity suits them for food container linings, as in the case of nitrocellulose lacquers, but vinyls are particularly useful in beer cans. Differing from vinyls by an additional chlorine atom per molecular unit, vinylidenes are even more resistant to chemical deterioration. Improved applications techniques which take into regard the extreme insolubility of these plastics will serve to broaden this field in the future.

### Silicones

"Thermal, electrical, and chemical resistance characterize the silicones (CORNELL ENGINEER, March 1947). They display some of our most desirable film-forming properties and should be put to good use when large-scale production of silicones becomes more feasible. Acrylate and styrene base resins have been tentatively suggested for several industrial uses, the most

(*Concluded on page* 38)

## Since 1905-

National Electric has been a symbol of Quality on Wiring Systems and Fittings for every conceivable requirement

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**Today—National Electric is the World's Largest Producer of Electrical Roughing-in Materials**

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***JANUARY AT THE CO-OP MEANS . . .***

After-Christmas bargain sales, and we'll be having lots of them.

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Height of the season on skis and ski equipment.

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Buying used textbooks from our customers, as the first term draws to a close.

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Special preparations and displays for St. Valentine's Day and for Junior Week.

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DROP IN OFTEN. THERE'LL BE SOMETHING NEW ALMOST EVERY DAY.

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**THE CORNELL CO-OP**

BARNES HALL — ON THE CAMPUS

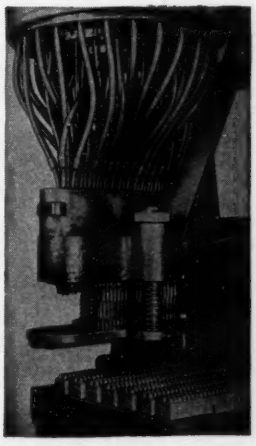
**PROBLEM** — Your company manufactures gas burners of varying number and spacing of gas ports. You want to develop a drilling machine which can be changed over with a minimum of time and effort to drill the holes in the different burner castings. How would you do it?

**THE SIMPLE ANSWER**—The illustration shows how one manufacturer solved this problem by using S.S.White flexible shafts as spindles. This arrangement makes possible quick changes of spindle groupings to meet different requirements. As here, S.S.White flexible shafts make ideal power drives for almost any machine part which must be adjustable.

* * *

This is just one of the hundreds of remote control and power drive problems to which S. S. White flexible shafts provide a simple answer. Engineers will find it worthwhile to be familiar with the range and scope of these "*Metal Muscles*"* for mechanical bodies.

* Trade Mark Reg. U. S. Pat. Off. and elsewhere.



**WRITE FOR BULLETIN 4501**

It gives essential facts and engineering data about flexible shafts and their application. Write for your free copy.

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## Protective Coatings

(*Concluded from page* 36)

successful of which has been the colorless thermoplastic methylmethacrylate employed on polished metal surfaces. In the solid condition, acrylates form Plexiglass, or Lucite, which bends light around corners, while polystyrenes enter into the synthetic rubber line. Copolymerization and further modifications may lead to results more satisfying to the coatings man."

"Only through intensive research can we satisfy the needs and desires of the individual customer. Each application of liquid plastics is an answer to specific problems of resistance to corrosion and mechanical abrasion, thermal stability, adhesion to surfaces, pliability of the film with bending of the material being coated, and color imparted. Our testing devices in the large physical properties laboratories subject specimens to radiation, salt sprays simulating sea water conditions, mechanical bending, and crimping, and the like."


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Manufacturers of Super-Refractories Only

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**REFRACTORY CRUCIBLES**
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**SPECIAL REFRACTORY BRICK, TILE, SHAPES**

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Developing high-voltage betatrons that look deep into steel for hidden flaws . . . turbines that utilize the tornado force of expanding gases . . . induction heaters and other electronic equipment . . . this is challenging work of absorbing interest. This is the work of Allis-Chalmers.

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**Allis-Chalmers Mfg. Co., Milwaukee 1, Wisconsin**

# STRESS and STRAIN...

**"I tell you I won't have this room," protested the old lady to the bellboy. "I'm not going to pay good money for a closet with a folding bed. If you think that just because I'm from the country—"**

**"Get in, lady, get in," the boy cut in wearily. "This isn't your room. This is the elevator."**

* * *

Engineer's attitude on new fashions: "I've got a swell memory."

* * *

**"There's nothing the matter with this state," declared the Arizona citizen defensively. "All we need is a better type of settler and more water."**

**"When you come to think of it," retorted the tourist, "That's all hell needs."**

* * *

*Recently a would-be chicken fancier had some difficulty with her flock and wrote the following letter to the Department of Agriculture.*

*"Something is wrong with my chickens. Every morning when I come out I find two or three lying on the ground cold and stiff with their feet in the air. Can you tell me what is the matter?"*

*After a little while she received the following letter from the Department:*

*"Dear Madam: Your chickens are dead."*

* * *

**Say it with flowers,**
**Say it with eats,**
**Say it with kisses,**
**Say it with sweets,**
**Say it with jewelry,**
**Say it with drink,**
**But always be careful**
**Not to say it with ink!**

* * *

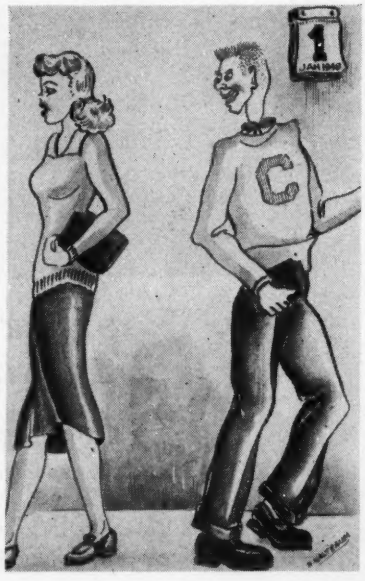
Drunk at pay phone: "Number, heck! I want my peanuts!"

A Long Island potato married an Idaho potato, and eventually they had a little sweet potato. The little one flourished, and in due time announced to its parents that it wanted to marry Gabriel Heatter. "But you can't marry Gabriel Heatter," declared the parents. "He's just a commentator."

* * *

**You've probably heard of the freshman engineer who thought steel wool came from hydraulic rams.**

* * *




**"I hereby resolve . . . "**

* * *

Arts student: "What is petty larceny?"

Engineer: "I'm not sure, but I think it has something to do with stealing your girl."

* * *

*Prof: "Why aren't you taking notes?"*

*Student: "I don't have to. I've got my grandfather's."*

*It was that sleepy time of the afternoon. The prof droned on and on: formulae, constants and figures. An engineer, sitting in the second row, was unable to restrain himself any longer and gave a tremendous yawn. Unfortunately, as he stretched out his arm he caught his neighbor squarely under the chin, knocking him to the floor. Horrified, he bent over the prostrate form just in time to hear a low murmur, "Hit me again, Sam, I can still hear him."*

* * *

**First Drunk: "We're getting closer to town."**

**Second Drunk: "How do you know?"**

**First Drunk: "We're hitting more people."**

* * *

Engineer to roommate: "Gad! Here it is—only three in the morning and I'm getting tired already!"

* * *

**A young lady found herself for the weekend with a notoriously straight-laced country family in England. Fearing that the pajamas she wore instead of a nightgown might be considered improper, she carefully hid them every morning when she got up. But one morning at breakfast she suddenly realized that she had forgotten them, that they were lying brazenly on her bed. Excusing, herself, she rushed to her room. The pajamas had disappeared.**

**While she was feverishly hunting for them, l o o k i n g vainly through the closets and drawers, a dour, elderly maid appeared at the door and surveyed. "If it's the pajamas you're looking for Miss," she said, "I put them back in the young gentleman's room."**